QL
1
.R454
NH

REVUE SUISSE DE ZOOLOGIE

VOLUME
129 (2) – 2022

Swiss Journal of Zoology

SMITHSONIAN
NOV 25 2022
LIBRARIES

muséum genève

Swiss Zoological Society

VILLE DE GENÈVE

REVUE SUISSE DE ZOOLOGIE
Swiss Journal of Zoology

VOLUME
129 (2) – 2022

La Revue suisse de Zoologie est éditée par le Muséum de la Ville de Genève et la Société suisse de Zoologie. Elle est subventionnée par l'Académie suisse des Sciences naturelles (SCNAT) et la Ville de Genève.

Comité de rédaction / Editorial board

Alice Cibois, Bernard Landry, Peter Schuchert, Muséum d'histoire naturelle de la Ville de Genève

Rédacteurs adjoints / Associate editors

I. Blasco-Costa (parasites), A. Cibois (Aves), R. Covain (poissons/fish), G. Cuccodoro (Coleoptera), B. Landry (Insecta, excl. Coleoptera), J. Hollier (Insecta), J. Mariaux (invertébrés excl. arthropodes/invertebrates excl. arthropods), M. Ruedi (Mammalia), A. Schmitz (Amphibia, Reptilia), P. Schwendinger (Arthropoda excl. Insecta), E. Toussaint (Coleoptera and Lepidoptera).

Soumission de manuscrits et abonnements / Submission of manuscripts and subscriptions

Revue suisse de Zoologie
Muséum d'histoire naturelle
Case postale 6434
1211 Genève 6
rsz.mhn@ville-ge.ch
Internet: http://institutions.ville-geneve.ch/fr/mhn/frontpage/revue-suisse-de-zoologie/

Prix de l'abonnement annuel (2 fascicules) / Annual subscription (2 issues)
Suisse CHF 130.–
Union postale CHF 150.–

Maquette de couverture: Doris Simon, Florence Marteau, Muséum d'histoire naturelle de la Ville de Genève
Composition et mise en page: Corinne Charvet, Muséum d'histoire naturelle de la Ville de Genève
Administration : Muséum d'histoire naturelle de la Ville de Genève
Impression: Centrale municipale d'achats et d'impression de la Ville de Genève

Photo de couverture: *Liphistius birmanicus,* Schwendinger *et al.,* ce volume

ISSN 0035 - 418 X

REVUE SUISSE DE
ZOOLOGIE
Swiss Journal of Zoology

VOLUME
129 (2) – 2022

Swiss Zoological Society

REVUE SUISSE DE ZOOLOGIE
Swiss Journal of Zoology

VOLUME
129 (2) – 2022

Zamani A. & Marusik Y.M. - A new species of *Plator* Simon, 1880 from Pakistan, with a supplementary description of *P. pandeae* Tikader, 1969 (Araneae: Trochanteriidae) 297-301

Hollier J., Marschall J. & Legendre F. - An annotated list of the Blattodea (Insecta) described by Henri de Saussure. Part 2: the Anaplectidae 303-308

Baldizzone G., Takács A., Szabóky S. & Bozsó M. - *Coleophora santonici* Baldizzone & Takács (Lepidoptera, Coleophoridae), new species from Hungary bred from *Artemisia santonicum* 309-322

Yin Z.W. - *Micropeplus shergyla* sp. nov., the first species of Micropeplinae from Tibet (Coleoptera: Staphylinidae) 323-327

Ronkay G., Ronkay L., Landry B. & Zilli A. - A revision of the *Apamea fasciata* (Leech, 1900) species complex (Noctuidae, Xyleninae, Apameini) 329-341

Cifuentes J., Gilgado J. D. & Bobbitt I. - The woodlice of Switzerland (Crustacea, Isopoda, Oniscidea), with 6 new records from heated greenhouses 343-367

Prajapati D. A. & Dudhatra A. V. - First record of the spider genus *Tanzania* Koçak & Kemal, 2008 from Asia, with the description of a new species (Arneae: Salticidae) 369-374

Schwendinger P. J., Huber S., Lehmann-Graber C., Ono H., Aung M. M. & Hongpadharakiree K. - A taxonomic revision of the *Liphistius birmanicus*-group (Araneae: Liphistiidae) with the description of five new species 375-424

Revue suisse de Zoologie (September 2022) 129(2): 297-301 ISSN 0035-418

A new species of *Plator* Simon, 1880 from Pakistan, with a supplementary description of *P. pandeae* Tikader, 1969 (Araneae: Trochanteriidae)

Alireza Zamani[1*] & Yuri M. Marusik[2, 3]

[1] *Zoological Museum, Biodiversity Unit, University of Turku, FI-20014, Finland*
[2] *Department of Zoology & Entomology, University of the Free State, Bloemfontein 9300, South Africa*
E-mail: yurmar@mail.ru
* *Corresponding author: zamani.alireza5@gmail.com*

Abstract: *Plator soastus* sp. nov. of the spider family Trochanteriidae Karsch, 1879 is described and illustrated on the basis of female specimens collected in the Swat Valley, representing the first record of the genus in Pakistan and its (north) westernmost record for the whole known range. Material of both sexes of *P. pandeae* Tikader, 1969 from northern India is also illustrated, and new morphological terms are proposed for certain sclerites of the male palp.

Keywords: Gnaphosoidea - India - SEM - Swat valley.

INTRODUCTION

Trochanteriidae Karsch, 1879 is a small family of spiders, currently comprising 50 extant species in six genera, primarily distributed in the pantropical regions, as well as 30 fossil species in six extinct genera from Baltic, Dominican, Rovno and Chiapas ambers (Dunlop *et al*., 2020; World Spider Catalog, 2022; Azevedo *et al*., 2022). Trochanteriids have a strongly flattened body, relatively elongated trochanters and noticeably laterigrade legs, and are typically found under bark or stones (Jocqué & Dippenaar-Schoeman, 2006). In Asia, the family is represented by a single genus, *Plator* Simon, 1880, with 16 species distributed from India to Japan (World Spider Catalog, 2022). Recently, we had the opportunity to examine some material of this genus collected in Pakistan, which represent a new species described and illustrated in this paper. Furthermore, based on material of *P. pandeae* Tikader, 1969 collected in northern India and using scanning electron microscopy, we propose new terms for certain previously unnamed sclerites of the male palp.

MATERIAL AND METHODS

Specimens were photographed using a Canon EOS 7D camera attached to an Olympus SZX16 stereomicroscope, and a JEOL JSM-5200 scanning electron microscope at the Zoological Museum of the University of Turku. Digital images were stacked using CombineZP and edited using CorelDraw graphic design software packages. Lengths of leg segments were measured on the dorsal side and listed as: total length (femur, patella, tibia, metatarsus, tarsus). The map was prepared using SimpleMappr (Shorthouse, 2010). The material examined is deposited at the Muséum d'histoire naturelle, Genève, Switzerland (MHNG) and at the Manchester Museum of the University of Manchester, UK (MMUE).

TAXONOMY

Family Trochanteriidae Karsch, 1879
Genus *Plator* Simon, 1880

Type species: *Plator insolens* Simon, 1880 from China, by monotypy.

Comments: This genus currently comprises 16 species known from India (5 spp.), China (12 spp.), Korea and Japan (one species each). Thanks to several recent regional revisions (Zhu *et al*., 2006; Lin & Zhu, 2016; Lin & Li, 2020; Sankaran *et al*., 2020), the group is relatively well studied, with most of the species (11) properly described on the basis of both sexes. Three species (*P. himalayaensis* Tikader & Gajbe, 1976a; *P. kashmirensis* Tikader & Gajbe, 1973; *P. solanensis* Tikader & Gajbe, 1976b) are known only from females, one only from males (*P. kamurai* Lin & Li, 2020), and for one species (*P. indicus* Simon, 1897) there are

Manuscript accepted 28.03.2022
DOI: 10.35929/RSZ.0076

no illustrations of the copulatory organs available in the literature, albeit having been described from both sexes (World Spider Catalog, 2022). The new species described in this paper represents the first record of the genus for Pakistan and the (north)westernmost record for the whole known range of the genus.

Plator soastus sp. nov.

Figs 1E-J, 4

Type material: MHNG; ♀ holotype and 1 ♀, 1 juvenile paratypes; PAKISTAN, Khyber Pakhtunkhwa Province, Swat District, above Utroor, in a forest of fir (*Abies*) and cedar, under the bark of a very large fallen cedar trunk, 2600 m; 13.05.1983; leg. Cl. Besuchet & I. Löbl.

Etymology: The specific epithet is a name in apposition, i.e. the ancient Greek name for the Swat River.

Diagnosis: The new species is most similar to *P. pandeae* and *P. dazhonghua* Lin & Li, 2020 by having anterior epigynal pockets (*Ap*). From the former species it can be distinguished by the completely fused pockets forming some kind of a narrow hood (*vs*. only indistinctly connected and forming a much wider structure), by glands (*Gl*) being as long as the oval receptacles (*Re*) (*vs*. glands much shorter than the round receptacles), and by the presence of an epigynal septum (*Se*) (*vs*. lacking). From *P. dazhonghua* it can be distinguished by the different shape of the anterior pockets (fused *vs*. separate) located at a larger distance from the copulatory openings (Fig. 1H cf. Lin & Li, 2020: fig. 2A), as well as by the considerably shorter copulatory ducts (or secondary spermathecae, *sensu* Lin & Li, 2020) (Fig. 1I cf. Lin & Li, 2020: fig. 2B).

Description: FEMALE (holotype). Habitus as in Fig. 1E-G. Total length 8.15. Carapace 2.65 long, 3.95 wide. Eye sizes: anterior median eye 0.17, anterior lateral eye 0.14, posterior lateral eye 0.20, posterior median eye 0.11. Carapace, sternum, labium, maxillae and chelicerae light brown. Legs of same color as carapace, without annulations. Legs I-II with numerous (especially leg I) and legs III-IV with a few erect ventral spiniform setae. Abdomen greyish dorsally, ventrally with dark patches on pale beige ground colour. Spinnerets uniformly light greyish brown. Measurements of legs: I 8.85 (3.09, 1.35, 1.94, 1.57, 0.90), II 12.17 (4.12, 1.62, 2.95, 2.32, 1.16), III 12.06 (4.11, 1.53, 2.92, 2.55, 0.95), IV 10.11 (3.43, 1.10, 2.40, 2.25, 0.93).

Epigyne as in Fig. 1H-J; plate 1.25 times wider than long, epigynal fovea shallow, more than three times wider than long, with weakly developed septum (*Se*, Fig. 1J); anterior pockets (*Ap*) fused and forming some kind of a hood; copulatory openings (*Co*) slit-like, transverse, located near lateral margin of fovea; copulatory ducts (*Cd*) large and broad, as wide as receptacles (*Re*); glands (*Gl*) long, more than four times longer than wide, slightly longer than receptacles; receptacles positioned in transverse plane, separated by about their length.

MALE. Unknown.

Distribution: Known only from the type locality in the Swat District, northern Pakistan (Fig. 4).

Plator pandeae Tikader, 1969

Figs 1A-D, 2-4

Plator pandeae Tikader, 1969: 253, figs 4-7 (♀). – Hu & Li, 1987: 360, figs 30.1-4, 31.1-4 (♂♀). – Hu, 2001: 279, fig. 160.1-4 (♂♀). – Zhu *et al*., 2006: 42, figs 20-24 (♂♀). All Chinese references refer to the same specimens. – Sankaran *et al*., 2020: 137, figs 10-14, 19-24 (♂♀; including a re-examination of type material).

Material: MMUE; 1 ♂, 1 ♀, 6 juveniles; INDIA, Himachal Pradesh, Kothi Village and environs, 32°18'N, 77°11'E, 2300-2600 m, under bark of spruce tree; 29.05-8.06.1999; leg. Y.M. Marusik.

Description: See Sankaran *et al*. (2020). Here we provide a detailed description of the palp and the epigyne, with an emphasis on information lacking in previous publications, and comment on the structure of the female tarsal claws.

MALE. Habitus as in Fig. 1B. Palp as in Figs 2-3; tibia large, almost as long as cymbium, twice longer than wide, with long and gradually tapering tibial apophysis having a slight curvature; cymbium almost triangular in lateral view (Fig. 2B); tegulum large, as long as cymbium in retrolateral view (Fig. 2B), wider than long in prolateral view (Fig. 2C); subtegulum (*St*) discoid, observable only in prolateral view (Figs 2C, 3C); tegulum with spine-like apophysis (*Ta*) (Fig. 3A); conductor (*Cn*) large, membranous, with a distoprolateral extension (Fig. 3C); embolus (*Em*) complex, with large base, tooth-like (in ventral view) distal ridge (*Et*) and concave mesal extension (*Me*) (Fig. 3A-C); embolus proper (*Ep*) (i.e. part containing opening of sperm duct) ribbon-shaped, circumflexing conductor, with serrated distal margin (Fig. 3A, C).

FEMALE. Habitus as in Fig. 1A. Palp with dentate claw having four small denticles in proximal half and bent at almost right angle (Fig. 3F). Tarsal claw of leg I with single series of four denticles in proximal half (Fig. 3G); denticles relatively larger than those of palpal claw.

Epigyne as in Figs 1C-D, 3E; epigynal fovea and septum indistinct; anterior part with a widely separated pair of pockets (*Ap*) connected by indistinct bridge but not fused; copulatory openings (*Co*) slit-like; copulatory ducts (*Cd*) longer than wide, with short glands (*Gl*) close to receptacles; receptacles (*Re*) globular, contiguous and located posteriorly.

Distribution: This species is currently known from four localities, three in India and one in southern Tibet, China (Fig. 4).

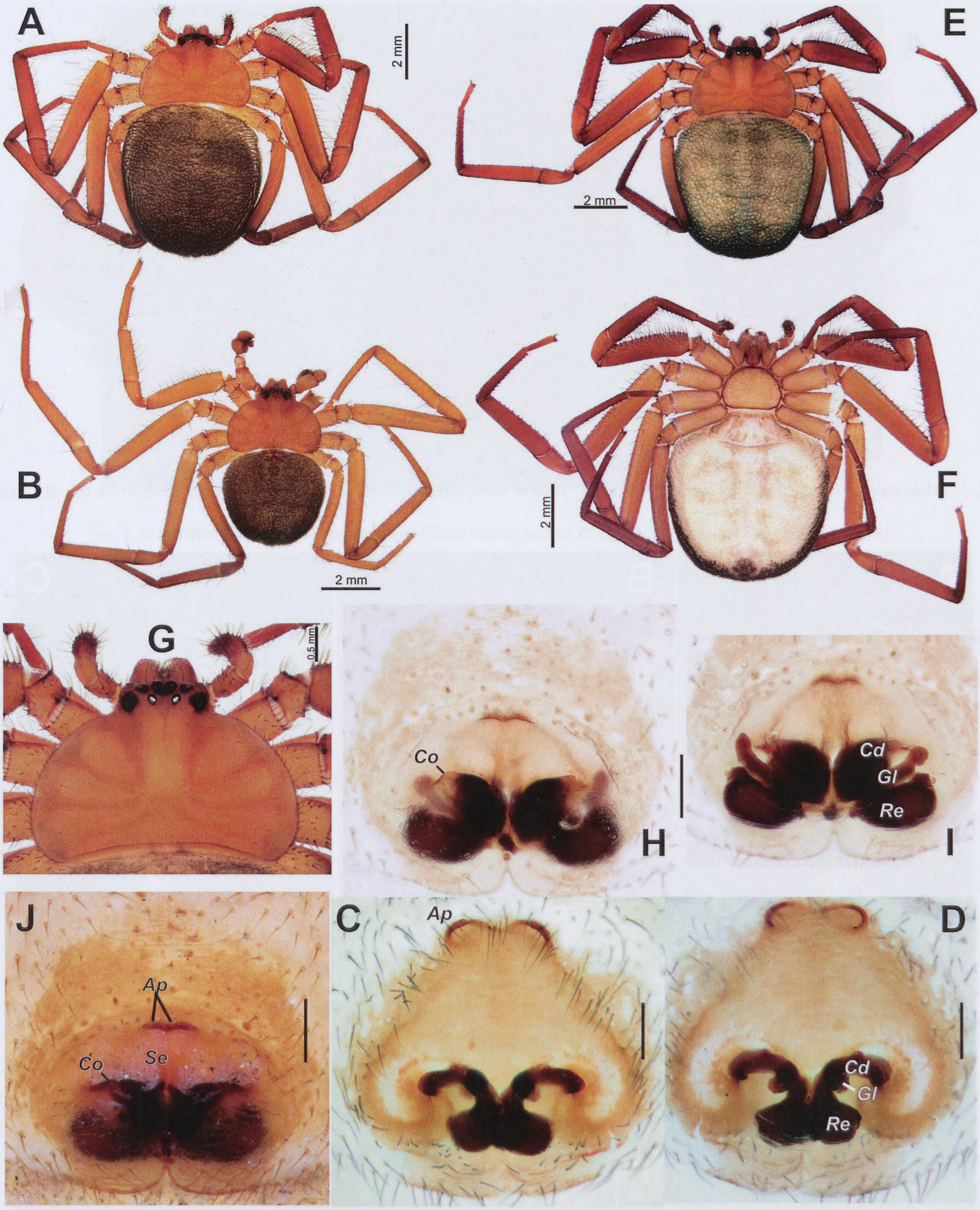


Fig. 1. Habitus and epigynes of *Plator pandeae* Tikader, 1969 (A-D) and *Plator soastus* sp. nov. (E-J). (A, E) Habitus of female, dorsal view. (B) Habitus of male, dorsal view. (F) Habitus of female, ventral view. (G) Prosoma of female, dorsal view. (C, H) Macerated epigyne, ventral view. (D, I) Vulva, dorsal view. (J) Intact epigyne, ventral view. Abbreviations: *Ap* - anterior pockets; *Cd* - copulatory duct; *Co* - copulatory opening; *Gl* - gland; *Re* - receptacle; *Se* - septum. Scale bars: 0.2 mm, unless stated otherwise.

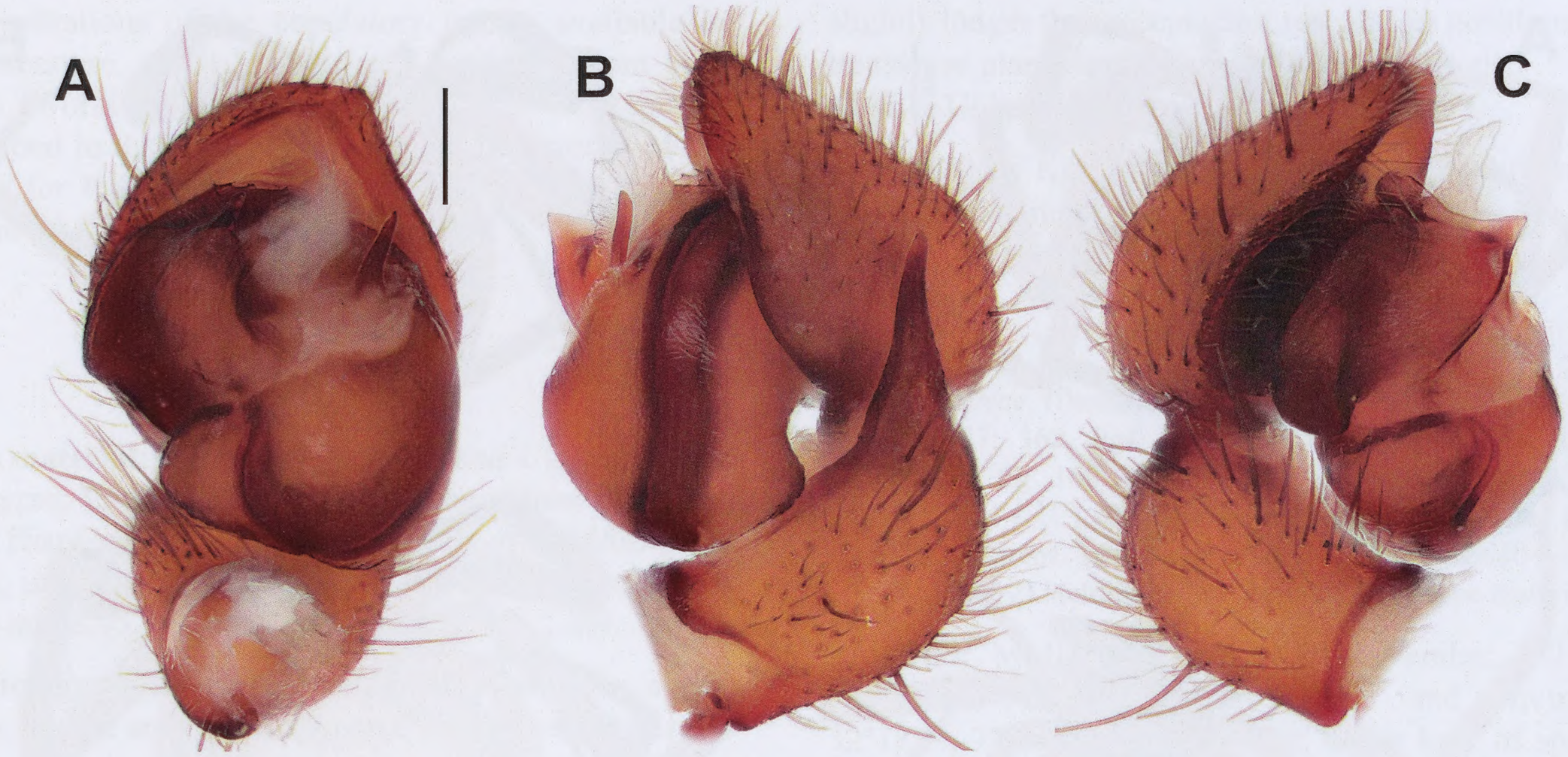


Fig. 2. Male palp of *Plator pandeae* Tikader, 1969. (A) Ventral view. (B) Retrolateral view. (C) Prolateral view. Scale bar: 0.2 mm.

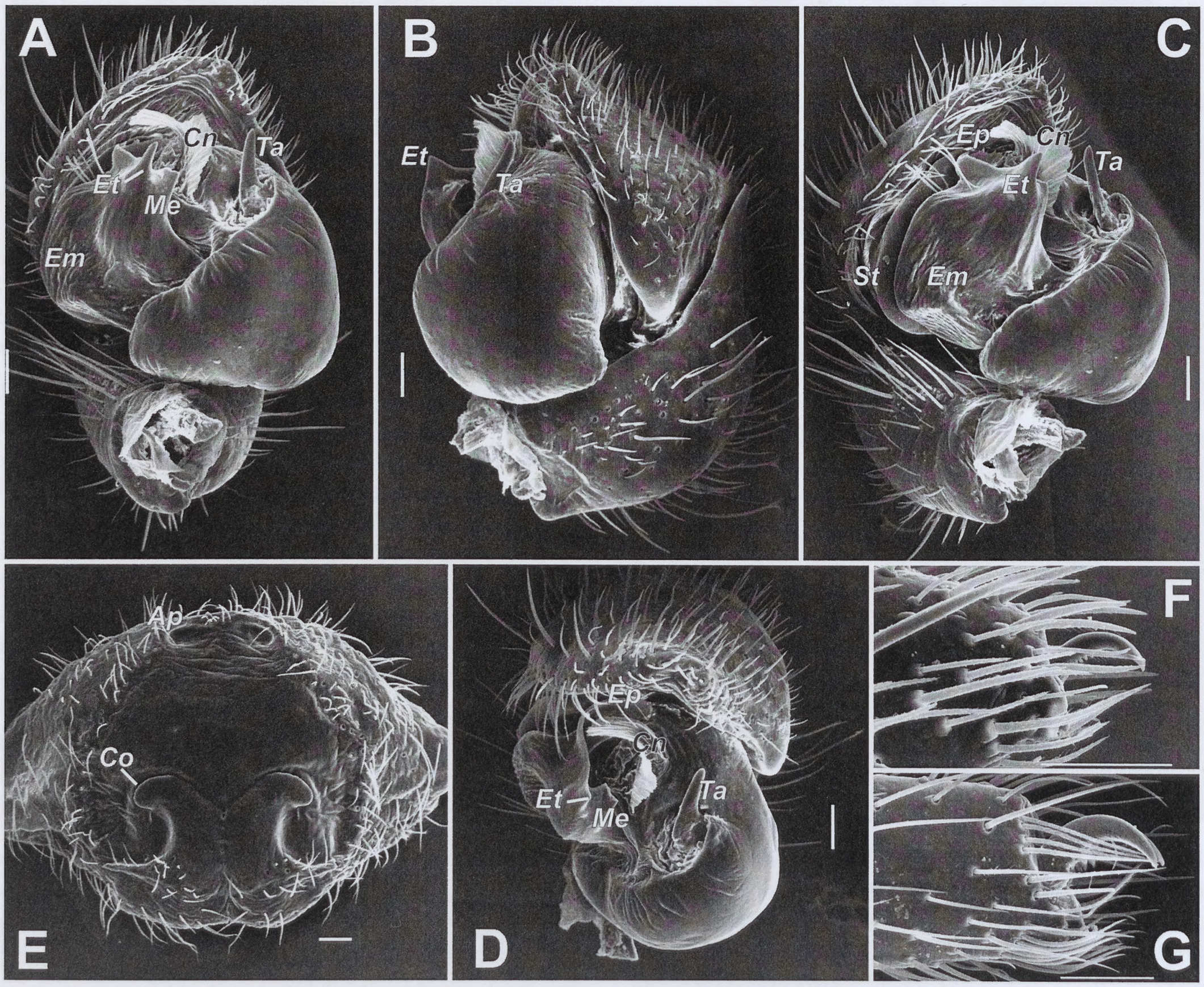


Fig. 3. Male palp (A-D), epigyne (E) and tarsal claws (F-G) of *Plator pandeae* Tikader, 1969. (A, E) Ventral view. (B) Retroventral view. (C) Proventral view. (D) Distal view. (F) Left female palp, prolateral view. (G) Left female tarsus I, prolateral view. Abbreviations: *Ap* - anterior pockets; *Cn* - conductor; *Co* - copulatory opening; *Em* - embolus; *Ep* - embolus proper; *Et* - tooth-like distal ridge; *Me* - mesal extension of embolic division; *Ta* - tegular apophysis; *St* - subtegulum. Scale bars: 0.1 mm.

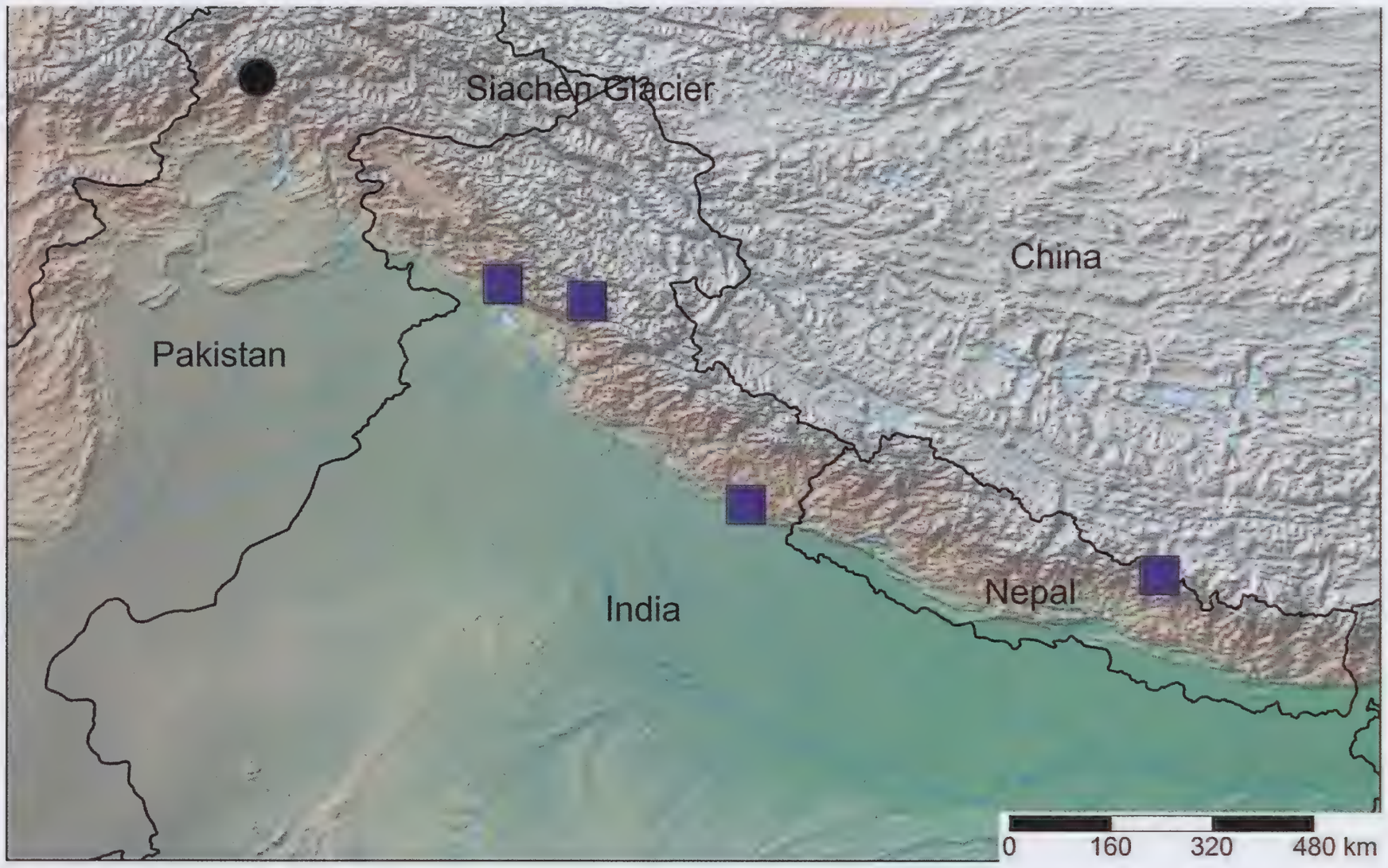


Fig. 4. Localities of *Plator soastus* sp. nov. (filled circle) and of *P. pandeae* Tikader, 1969 (filled squares).

ACKNOWLEDGMENTS

The first author is grateful to Lionel Monod and Peter J. Schwendinger for help during his visit to the MHNG and for providing the studied material. The comments of Pradeep M. Sankaran (Sacred Heart College, Cochin, India) and of the subject editor (Peter J. Schwendinger) on an earlier draft of the manuscript are also acknowledged.

REFERENCES

Azevedo G.H.F, Bougie T., Carboni M., Hedin M., Ramírez M.J. 2022. Combining genomic, phenotypic and sanger sequencing data to elucidate the phylogeny of the two-clawed spiders (Dionycha). *Molecular Phylogenetics and Evolution* 166(107327): 1-14.

Dunlop J.A., Penney D., Jekel D. 2020. A summary list of fossil spiders and their relatives (pp. 1-303). *In*: World Spider Catalog, version 23.0. Natural History Museum Bern. Available at http://wsc.nmbe.ch (accessed on 11.03.2022).

Hu J.L. 2001. Spiders in Qinghai-Tibet Plateau of China. *Henan Science and Technology Publishing House, Zhengzhou*, 658 pp.

Hu J.L., Li A.H. 1987. The spiders collected from the fields and the forests of Xizang Autonomous Region, China (pp. 315-392). *In*: Sheng-Chang H. (ed.). Agricultural insects, spiders, plant diseases and weeds of Xizang, vol. 1. *Xizang ren min chu ban she*, 463 pp.

Jocqué R., Dippenaar-Schoeman A.S. 2006. Spider families of the world. *Musée Royal de l'Afrique Central, Tervuren*, 336 pp.

Karsch F. 1879. Arachnologische Beiträge II. Die Aranëidengattung *Trochanteria*. *Zeitschrift für die gesammten Naturwissenschaften* 52: 536-539, pl. 7.

Lin Y.J., Li S.Q. 2020. Taxonomic studies on six species of the genus *Plator* (Araneae: Trochanteriidae) from China. *Zoological Systematics* 45(1): 24-39.

Lin Y.J., Zhu G.X. 2016. A new species of the spider genus *Plator* (Trochanteriidae) from south China. *Zootaxa* 4162(1): 189-192.

Sankaran P.M., Caleb J.T.D., Sebastian P. A. 2020. The species of the genus *Plator* Simon, 1880 in India (Araneae: Trochanteriidae). *Zootaxa* 4852(1): 133-141.

Shorthouse D.P. 2010. SimpleMappr, an online tool to produce publication-quality point maps. Available at http://www. simplemappr.net (accessed on 11.03.2022).

Simon E. 1880. Etudes arachnologiques. 11e Mémoire. XVII. Arachnides recueillis aux environs de Pékin par M. V. Collin de Plancy. *Annales de la Société Entomologique de France* (5) 10: 97-128.

Simon E. 1897. Histoire naturelle des araignées. Deuxième édition, tome second. *Roret, Paris*, 192 pp.

Tikader B.K. 1969. Studies of some rare spiders of the families Selenopidae and Platoridae from India. *Proceedings of the Indian Academy of Science* 69(B): 252-255.

Tikader B.K., Gajbe U.A. 1973. A new species of spider of genus *Plator* Simon (family-Platoridae) from India. *Current Science* 42: 829.

Tikader B.K., Gajbe U.A. 1976a. A new species of spider of the genus *Plator* Simon (family-Platoridae) from Almora, India. *Journal of the Bombay Natural History Society* 73: 178-179.

Tikader B.K., Gajbe U.A. 1976b. A new species of spider of the genus *Plator* Simon (family: Platoridae) from India. *Journal of the Bombay Natural History Society* 72: 797-799.

World Spider Catalog 2022. World Spider Catalog. Version 23.0. Natural History Museum Bern. Available at http://wsc.nmbe.ch (accessed on 11.03.2022).

Zhu M.S., Tang G.M., Zhang F., Song D.X. 2006. Revision of the spider family Trochanteriidae from China (Araneae: Gnaphosoidea). *Zootaxa* 1140: 31-51.

Revue suisse de Zoologie (September 2022) 129(2): 303-308 ISSN 0035-418

An annotated list of the Blattodea (Insecta) described by Henri de Saussure. Part 2: the Anaplectidae

John Hollier[1*], Judith Marshall[2] & Frédéric Legendre[3]

[1] *Muséum d'histoire naturelle de Genève, C.P. 6434, CH-1211 Genève 6, Switzerland*
[2] *Natural History Museum, Cromwell Road, London SW7 5BD, UK*
[3] *Institut de Systématique, Evolution, Biodiversité (ISYEB), Muséum national d'Histoire naturelle, CNRS, Sorbonne Université, EPHE, Université des Antilles, C.P. 50, 57 rue Cuvier, F-75005 Paris, France*
* *Corresponding author: john.hollier@ville-ge.ch*

Abstract: Henri de Saussure described 20 species currently placed in the family Anaplectidae, some of them in collaboration with Leo Zehntner. These species are listed alphabetically with an account of the type specimens in the Muséum d'histoire naturelle de Genève. The location of type specimens in other museums is given where known. The current binominal combination for each species is provided.

Keywords: Cockroaches - Geneva - London - Mexico.

INTRODUCTION

Henri de Saussure (1829-1905) was a prolific Genevan naturalist who described over three thousand species and many higher taxa (Hollier & Hollier, 2013). His interest in cockroaches began with his expedition to the Antilles and Mexico in 1854-1856 (Hollier & Hollier, 2012), and his first publications on the group were descriptions of species he had captured during his trip, or specimens sent to him by François Sumichrast, a Swiss naturalist who had accompanied Saussure on his exhibition but remained in Mexico when Saussure returned to Geneva. He returned to this insect group in the 1890s, partly working with the young Swiss entomologist Leo Zehntner (1864-1961) who acted as Saussure's assistant before going on to a distinguished career as a tropical applied entomologist (Hollier & Hollier, 2018). Saussure (alone and with Zehntner) is the author of 578 species level names in the Blattodea. The early descriptions are generally rudimentary and in most of his descriptions Saussure did not designate holotypes or even enumerate the number of specimens he had studied. He did not always state where the specimens were deposited. Nomenclature follows Beccaloni (2014).

Saussure described 20 species currently placed in the family Anaplectidae. These are listed in the following.

ARRANGEMENT AND FORMAT

The species are listed alphabetically following the format used in Hollier *et al*. (2020).

The following abbreviations are used:

CSF	Cockroach Species Files Online (Beccaloni, 2014)
MCSN	Museo Civico di Storia Naturale "Giacomo Doria", Genoa
MHNG	Muséum d'histoire naturelle de Genève
MIZW	Museum and Institute of Zoology, Warsaw
MNHN	Muséum national d'histoire naturelle, Paris
NHMUK	Natural History Museum, London

CATALOGUE

africana Saussure, 1895: 70-71 [*Anaplecta*]
Africa equatorialis; Ladò (E. Dabbene). Unspecified number of ♀.
No specimens found in the MHNG collection. There is a ♀ specimen in the MCSN labelled as the holotype (Poggi, 2021).
Anaplecta cincta africana Saussure, 1895

alaris Saussure & Zehntner, 1893: 19, 27 [*Anaplecta*]
Peru (Mus. Genavense). Unspecified series.
The MHNG collection contains 2 specimens. A ♀ specimen (MHNG-ARTO-0020348) with labels: "♀

Manuscript accepted 20.05.2022
DOI: 10.35929/RSZ.0077

Perou, Mr C. Jelsky" [handwritten on ruled white card]; "Anaplecta alaris Sauss." [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is glued to a small card mount, with the right front wing roughly spread. The right hind wing is glued to a separate card mount on the same pin. The head and the anterior of the thorax are missing, and the front legs are hidden by the mount. The left hind wing, the tarsi of the right middle leg and the tibia and tarsi of both hind legs are lost. There is insect feeding damage to the end of the abdomen. A damaged specimen (MHNG-ARTO-0020347) with labels: "Monte-Rico, 1870, Pérou C. Jelski" [handwritten on white paper]; "Perou M. C Jelsky" [handwritten on ruled white card]; "Anaplecta alaris Sauss." [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is glued to a small card mount, with the wings folded. Most of the right antenna and most of the left antenna, the ends of the femur, tibia and tarsi of all legs and the abdomen are lost. Box Blattodea 27.
Anaplecta alaris Saussure & Zehntner, 1893

albomarginata Saussure & Zehntner, 1893: 20, 26 [*Anaplecta*]
Mexico, Tabasco (H. H. Smith). Unspecified number of ♀.
No specimens found in the MHNG collection. There is a ♀ specimen in the NHMUK (NHMUK014422956) with the printed label "Tabasco, Teapa, March, H.H. Smith", labelled as the holotype.
Anaplecta albomarginata Saussure & Zehntner, 1893

azteca Saussure, 1868: 97 [*Anaplecta*]
Mexico. Unspecified number of ♂ and ♀.
Saussure (1870) stated that he had five ♂ and three ♀ collected by Sumichrast in Orizaba.
The MHNG collection contains six specimens. A ♂ specimen (MHNG-ARTO-0020328) with labels: "♂ R. Blanco, Mexique, Sumichrast" [handwritten on ruled white card]; "Anaplecta Azteca Sss. ♂" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings folded. Most of both antennae, both front legs, the left middle leg and the tarsi of the right hind leg are lost. A ♂ specimen (MHNG-ARTO-0020329) with labels: "♂ R. Blanco, Mexique, env. Sumichrast" [handwritten on ruled white card]; "Anaplecta Azteca Sss. ♂" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings folded. Both front legs, the tarsi of the left middle leg, the tarsi of the right hind leg and the entire left hind leg are missing, and the abdomen is also lost. A ♀ specimen (MHNG-ARTO-0020330) with labels: "♀ R. Blanco, Mexique, Sumichrast" [handwritten on ruled white card]; "Anaplecta Azteca Sss. ♀" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings folded. Most of the right antenna, the left front leg, both middle legs and both hind legs are missing. The abdomen is detached and glued to a card mount secured on the original pin. A ♀ specimen (MHNG-ARTO-0020331) with labels: "♀ R. Blanco, Mexique, Sumichrast" [handwritten on ruled white card]; "Anaplecta Azteca Sss. ♀" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings folded. The left middle leg, the left hind leg, and the tarsi of the right hind leg are missing. The left hind wing is detached and glued to a card mount secured on the original pin. A ♂ specimen (MHNG-ARTO-0020332) with labels: "♂ R. Blanco, Mexique, Sumichrast" [handwritten on ruled white card]; "Anaplecta Azteca Sss. ♂" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings folded. The antennae, front legs, middle legs and much of the abdomen are missing, and the specimen has been repaired with glue so that the hind legs are stuck to the rest of the abdomen. A ♂ specimen (MHNG-ARTO-0020333) with labels; Anaplecta Azteca Sss. ♂" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is represented by fragments glued to a card mount: the left front wing, both hind wings, the abdomen and parts of two legs are present. Box Blattodea 27. The whereabouts of the other syntypes is unknown. Maes *et al*. (2020) mention a ♂ lectotype in the MHNG but do not explicitly designate one or indicate which specimen is referred to; this cannot be accepted as a valid lectotype designation.
Ananplecta azteca Saussure, 1868

decipiens Saussure & Zehntner, 1893: 19, 27, pl. 3 fig. 5, pl. 4 figs 10-11 [*Anaplecta*]
Mexico, Vera Cruz and Tabasco (H. H. Smith). Unspecified number of ♂ and ♀.
No specimens found in the MHNG collection. There are two specimens in the NHMUK. A ♂ (NHMUK014422957) and a ♀ (NHMUK014422958) are mounted together, with the printed data label "Vera Paz, El Jicaro, Champion". Although the locality does not match that in the description these specimens may well be syntypes (Saussure may have confused Vera Paz and Vera Cruz in his notes).
A junior synonym of *Anaplecta fallax* Saussure, 1862

dohrniana Saussure & Zehntner, 1893: 19, 28, pl. 3 fig. 3, pl. 4 fig. 15 [*Anaplecta*]
Guatemala (coll. Dohrn). Unspecified number of ♂ and ♀.
The MHNG collection contains one ♀ specimen (MHNG-ARTO-0020352) with labels: "Guatemala" [handwritten on a strip of white card]; "Anaplecta Dohrniana ♀ Sauss." [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the right front wing roughly spread. The left front wing and right hind wing are glued to a card mount on the original pin. The right antenna is lost. Box Blattodea 27. Much of Dohrn's collection is currently in the MIZW, but no specimens of this species were found there.
Anaplecta dohnrniana Saussure & Zehntner, 1893

domestica Saussure & Zehntner, 1893: 19, 26-27 [*Anaplecta*]
Guatemala, in the city (Champion). Unspecified number of ♀.
The MHNG collection contains two specimens. A ♀ specimen (MHNG-ARTO-0020349) with labels: "Guatemala City, Champion" [printed on white card]; "Anaplecta domestica Sauss." [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is glued to a card mount, with the wings folded, and some of the legs are hidden by the mount. Most of both antennae and the tarsi of the right hind leg are lost. A specimen labelled as ♂ (MHNG-ARTO-0020350) with labels: "♂" [printed on white card]; "Guatemala City, Champion" [printed on white card]; "Anaplecta domestica Sauss." [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is glued to a card mount, with the left front wing roughly spread. The head and front of the thorax, the left hind wing, both front legs and the left middle and hind legs are missing. Although the original description does not mention ♂ characters, the locality label indicates that this specimen is a syntype. Box Blattodea 27. There are four ♀ specimens in the NHMUK (NHMUK014422959-NHMUK014422962), each with the printed data label "Guatemala City, Champion" and labelled as syntypes.
Anaplecta domestica Saussure & Zehntner, 1893

elliptica Saussure & Zehntner, 1893: 19, 27-28, pl. 3 fig. 2, pl. 4 fig. 8 [*Anaplecta*]
Guatemala (coll. Dohrn). Unspecified number of ♀.
No specimens found in the MHNG collection. Much of Dohrn's collection is currently in the MIZW, but no specimens of this species were found there and the type material is apparently lost.
Anaplecta elliptica Saussure & Zehntner, 1893

fallax Saussure, 1862: 163-164 [*Anaplecta*]
Guatemala. Unspecified series.
The MHNG collection contains two specimens under this name, but one of them (MHNG-ARTO-0020343) is from Mexico and cannot be part of the type series. The other specimen (MHNG-ARTO-0020341) has the labels: "Guatemala, coll. Guérin" [handwritten on ruled white card]; "Anaplecta fallax Sauss. ♀" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings folded. The left antenna and all of the legs are lost. The type series was not defined and so this specimen must be considered a syntype. Box Blattodea 27.
Anaplecta fallax Saussure, 1862

grandipennis Saussure & Zehntner, 1893: 20, 25, pl. 4 fig. 5 [*Anaplecta*]
Brazil, Pernambuco. Unspecified number of ♂ and ♀.
The MHNG collection contains four specimens. A ♀ specimen (MHNG-ARTO-0020336) with labels: "Pernambouc, Brésil, M H de Saussure" [handwritten on ruled white card]; "Anaplecta grandipennis Sauss. ♀" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is glued to a card mount, with the wings roughly folded. Most of both antennae, the tarsi of the right front and middle legs and all of both hind legs are lost. A ♀ specimen (MHNG-ARTO-0020337) with labels: "Pernambouc, Brésil, M H de Saussure" [handwritten on ruled white card]; "Anaplecta grandipennis Sauss. ♀" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is glued to a card mount, with the wings roughly folded. Most of both antennae and the left middle and hind legs are lost. A specimen (MHNG-ARTO-0020338) with labels: "Pernambouc, Brésil, M H de Saussure" [handwritten on ruled white card]; "Anaplecta grandipennis Sauss. ♀" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is glued to a card mount, with the wings folded. The left front leg, both middle legs and both hind legs are missing. The end of the abdomen is not visible and the sex of the specimen is not identifiable. A specimen (MHNG-ARTO-0020339) with labels: "Pernambouc, Brésil, M H de Saussure" [handwritten on ruled white card]; "Anaplecta grandipennis Sauss. ♀" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is glued to a card mount. There is insect feeding damage to the specimen and all appendages and much of the abdomen is lost. Box Blattodea 27.
Anaplecta grandipennis Saussure & Zehntner, 1893

javanica Saussure, 1895: 71 [*Anaplecta*]
Java; Batavia. Unspecified series.
The MHNG collection contains three specimens. A specimen (MHNG-ARTO-0020355) with labels: "Batavie, été 85" [handwritten on white card]; "Anaplecta javanica Sss." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. The specimen is pinned to a card mount, with the wings roughly folded. Only the left front and middle legs and right middle and hind legs are visible, and it was not possible to identify the sex of the specimen. A specimen (MHNG-ARTO-0020356) with labels: "Batavie, été 85" [handwritten on white card]; "Anaplecta javanica Sss." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. The specimen is glued to a card mount; the left front and hind wings are detached and glued to a second card mount secured on the original pin. A piece of detached antenna and parts of two detached legs are glued next to the specimen; the left legs are in place, the hind leg having lost the tarsi, but the right legs are hidden by the mount and it was not possible to identify the sex of the specimen. A specimen (MHNG-ARTO-0020357) with labels: "Batavie, été 85" [handwritten on white card]; "Anaplecta javanica Sss." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. The specimen is glued to a card mount, with the left wings roughly spread. The antennae and the right wings are missing. The legs of the left side are hidden by

the mount. There is insect feeding damage to the end of the abdomen and it was not possible to identify the sex of the specimen.
Box Blattodea 27.
Anaplecta javanica Saussure, 1895

major Saussure & Zehntner, 1893: 20, 24, pl. 4 fig. 6 [*Anaplecta*]
Peru, Tarma. Unspecified number of ♀.
The MHNG collection contains one hind wing glued to a card mount (MHNG-ARTO-0020351). The mount has "Anaplecta ~~peruviana Sss~~ ♀ major Sss" handwritten on it, and the pin holding the mount has the labels "Anaplecta major Sauss. ♀" [handwritten on green paper] and "Syntypus" [printed on red paper]. The type series was not defined and so this specimen must be considered part of a syntype. Box Blattodea 27.
Anaplecta major Saussure & Zehntner, 1893

mexicana Saussure, 1868: 97 [*Anaplecta*]
Mexico. Unspecifed number of ♂ and ♀.
Saussure (1870) stated that he had fourteen ♂ and fifteen ♀ collected by Sumichrast in Orizaba.
The MHNG collection contains eleven specimens. A ♂ specimen (MHNG-ARTO-0020310) with labels: "♂ R. Blanco, Mexique, Sumichrast" [handwritten on ruled white card]; "Anaplecta mexicana Sauss." [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings folded. The left antenna and the right legs are missing. A ♂ specimen (MHNG-ARTO-0020311) with labels: "♂ R. Blanco, Mexique, Sumichrast" [handwritten on ruled white card]; "Anaplecta mexicana Sauss. ♂" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings folded. The right front leg, the tarsi of the left middle leg and the right hind leg are missing. A ♂ specimen (MHNG-ARTO-0020312) with labels: "♂ R. Blanco, Mexique, Sumichrast" [handwritten on ruled white card]; "Anaplecta mexicana Sauss." [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings folded. The right front leg, right middle leg and both hind legs are missing. There is insect feeding damage to the abdomen, and the terminalia are lost. A ♂ specimen (MHNG-ARTO-0020313) with labels: "♂ R. Blanco, Mexique, Sumichrast" [handwritten on ruled white card]; "Anaplecta mexicana Sauss. ♂" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings folded. The ends of both antennae, the tibia and tarsi of the left front leg and both hind legs are missing. A ♀ specimen (MHNG-ARTO-0020314) with labels: "♀ R. Blanco, Mexique" [handwritten on ruled white card]; "Anaplecta mexicana Sauss." [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings folded. Both antennae and both hind legs are lost. The left hind wing is detached and glued to a card mount on the original pin. A ♂ specimen (MHNG-ARTO-0020315) with labels: "♂ R. Blanco, Mexique, Sumichrast" [handwritten on ruled white card]; "Anaplecta mexicana" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings roughly folded. Both antennae, the left front leg, the tarsi of the right front leg, the left middle leg, both hind legs and the left front wing are missing. The left hind wing is detached and glued to a card mount on the original pin. A ♀ specimen (MHNG-ARTO-0020316) with labels: "Anaplecta Mexicana Sauss." [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen consists of fragments: the wings, the prothoracic tergite and the end of the abdomen are glued to a card mount. A ♀ specimen (MHNG-ARTO-0020317) with labels: "♀ R. Blanco, Mexique, Sumichrast" [handwritten on ruled white card]; "Anaplecta mexicana Sauss. ♀" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings folded. The left antenna, the left front leg, the tarsi of the right middle leg and both hind legs are lost. The specimen is broken where the pin was inserted and the rest of the thorax and the abdomen have been glued to a card mount on the original pin. A ♀ specimen (MHNG-ARTO-0020318) with labels: "♀ R. Blanco, Mexique, Sumichrast" [handwritten on ruled white card]; "Anaplecta mexicana Sauss. ♀" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings folded. Most of both antennae, the left front leg, right middle leg and the tarsi of the left hind leg are missing. A ♀ specimen (MHNG-ARTO-0020319) with labels: "♀ R. Blanco, Mexique, Sumichrast" [handwritten on ruled white card]; "Anaplecta mexicana Sss." [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen was directly pinned, with the wings folded, but only the wings and part of the thorax remain. A ♀ specimen (MHNG-ARTO-0020320) with labels: "♀ R. Blanco, Mexique, Sumichrast" [handwritten on ruled white card]; "Anaplecta mexicana Sauss." [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen was directly pinned, with the wings folded, but only the wings and part of the thorax remain directly on the pin. Part of the abdomen is glued to a card mount on the original pin. Box Blattodea 27.
There are two specimens labelled as syntypes in the MNHN. MNHN-EP-EP1396 with handwritten labels: "Mexique" and "6056" and MNHN-EP-EP1397 with a handwritten label: "♀ R. Blanco, Mexique". The whereabouts of the other syntypes is unknown. Maes *et al*. (2020) mention a ♂ lectotype in the MHNG but do not explicitly designate one or indicate which specimen is referred to; this cannot be accepted as a valid lectotype designation.
Anaplecta mexicana Saussure, 1868

moxa Saussure & Zehntner, 1893: 19, 23, pl. 4 figs 3-4 [*Anaplecta*]
Peru, Tarma (Mus. Genavense). Unspecified number of ♀.
The MHNG collection contains one ♀ specimen (MHNG-ARTO-0020326) with labels: "Tarma, Pérou, M H de Saussure" [handwritten on ruled white card]; Anaplecta moxa Sauss. ♀ [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings roughly spread. The left hind wing is glued to a card mount on a separate pin (MHNG-ARTO-0020327) with the label "Pérou, M H. de Saussure" [handwritten on ruled card], and "Anaplecta moxa Ss. Pérou" is handwritten on the mount. The left front leg and the tarsi of both middle and both hind legs are missing, and the abdomen appears to have been strengthened or re-attached with glue. The type series was not defined and so this specimen is considered a syntype. Box Blattodea 27.
Anaplecta moxa Saussure & Zehntner, 1893

nahua Saussure, 1868: 354 [*Anaplecta*]
Mexico. Unspecified series.
The MHNG collection contains one damaged specimen (MHNG-ARTO-0020325) with labels: "Mexique" [handwritten on ruled white card]; "Anaplecta nahua Sauss." [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings roughly spread. The left hind wing is glued to a card mount on a separate pin (MHNG-ARTO-0020324) with the label "Anaplecta nahua Sauss" [handwritten on green paper]. Most of both antennae, both middle legs, the tarsi of the left hind leg, the entire right hind leg and the abdomen are missing. The type series was not defined and so this specimen is considered a syntype. Box Blattodea 27.
Anaplecta nahua Saussure, 1868

otomia Saussure, 1869: 238, fig. 18 [*Anaplecta*]
Mexico. Unspecified number of ♀.
The MHNG collection contains one ♀ specimen (MHNG-ARTO-0020335) with labels: "♀ Mexique, M H. de Saussure" [handwritten on ruled white card]; "Anaplecta otomia Sauss. ♀" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings roughly spread. The left hind wing is glued to a card mount on a separate pin (MHNG-ARTO-0020334) with labels: "♀ Mexique, M H. de Saussure" [handwritten on ruled white card]; "Anaplecta otomia Sauss. ♀" [handwritten on green paper]. The right front leg, the tarsi of the left front leg and the entire left hind leg are lost and the abdomen is partly detached. The type series was not defined and so this specimen is considered a syntype. Box Blattodea 27.
Anaplecta otomia Saussure, 1869

parvipennis Saussure & Zehntner, 1893: 19, 26 [*Anaplecta*]
Mexico, Tabasco (H. H. Smith). Unspecified series (variation mentioned).
The MHNG collection contains one ♂ specimen (MHNG-ARTO-0020340) with labels: "Teapa, Tabasco, H.H.S." [printed on white card]; "Anaplecta parvipennis Sauss. ♂" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the front wings spread. The left hind wing and the left middle leg are glued to a card mount on the original pin. The right antenna, the claw of the left hind leg and the tarsi of the right hind leg are missing. Box Blattodea 27. There are three specimens in the NHMUK labelled as syntypes. Two ♂ (NHMUK014422963 and NHMUK014422964) and one ♀ (NHMUK014422965), all with printed data labels "Tabasco, Teapa, H.H. S.".
A junior synonym of *Anaplecta fallax* Saussure, 1862

peruviana Saussure & Zehntner, 1893: 18, 23 [*Anaplecta*]
Peru. Unspecified series.
The MHNG collection contains one ♂ specimen (MHNG-ARTO-0020321) with labels: "♂ Tarma, Pérou, M H de Saussure" [handwritten on ruled white card; "Anaplecta peruviana Sauss. ♂" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is directly pinned, with the wings roughly folded. The abdomen is detached and glued to a card mount secured on the original pin, the right hind wing is glued to a card mount on a separate pin (MHNG-ARTO-0020322) with the label "Anaplecta peruviana Sauss. ♂" [handwritten on green paper]. The right antenna, the tibia and tarsi of the right middle leg and the tarsi of the right hind leg are missing. The type series was not defined and so this specimen is considered a synytpe. Box Blattodea 27.
Anaplecta peruviana Saussure & Zehntner, 1893

replicata Saussure & Zehntner, 1893: 20, 25, pl. 4 fig. 12 [*Anaplecta*]
Brazil, Pernambuco. Unspecified number of ♂ and ♀.
The MHNG collection contains three specimens. A ♀ specimen (MHNG-ARTO-0020346) with labels: "Pernambuc, Brésil, M H. de Saussure" [handwritten on ruled white card]; "Anaplecta replicata Sauss. ♀" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is glued to a card point, with the wings roughly spread. The right wings are glued to a transparent mount secured on the original pin. The left hind wing is glued to a card mount on a separate pin (MHNG-ARTO-0020342), with "Anaplecta replicata Sss ♀" handwritten on the mount. The antennae are lost and apart from the femorae the legs are hidden by the mount. A ♀ specimen (MHNG-ARTO-0020345) with labels: "Pernambuc, Brésil, M H. de Saussure" [handwritten on ruled white card]; "Anaplecta replicata Sauss. ♀" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is glued to a card point, with

the wings folded. Most of the left antenna is missing and the legs are largely hidden by the mount. A damaged specimen (MHNG-ARTO-0020344) with labels: "Pernambuc, Brésil, M H. de Saussure" [handwritten on ruled white card]; "Anaplecta replicata Sauss. ♂?" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is glued to a card point, with the wings roughly folded. The antennae, the right front leg, the right middle leg, both hind legs and the abdomen are missing. Box Blattodea 27.
Anaplecta replicata Saussure & Zehntner, 1893

tolteca Saussure, 1868: 354 [*Anaplecta*]
Mexico. Unspecified number of ♀.
The MHNG collection contains one ♀ specimen (MHNG-ARTO-0020323) with labels: "♀ Mexique env. Sumichrast" [handwritten on ruled white card]; "Anaplecta tolteca Sauss. ♀" [handwritten on green paper]; "Syntypus" [printed on red paper]. The specimen is pinned on a fine pin that is supported by a strip of cork on a larger one. The head and the left hind wing are glued to a card mount on the fine pin. Most of both antennae, both right wings, the claw of the left middle leg, the entire right middle and hind legs and the tibia and tarsi of the left hind leg are missing. Box Blattodea 27.
Anaplecta tolteca Saussure, 1868

In addition, the MHNG collection contains a syntype of *Anaplecta dahomensis* Shelford, 1906 (MHNG-ARTO-0020358) that was donated by Malcolm Burr (see Hollier, 2008) and a paratype of *A. falcifer* Hebard, 1925 (MHNG-ARTO-0020353) and two paratypes of *A. hemiscotia* Hebard, 1920 (MHNG-ARTO-0020359 and MHNG-ARTO-0020360) that were probably exchanged for Saussure syntypes by Hebard (see Hollier & Heads, 2014).

AKNOWLEDGEMENTS

Thanks are due to Anita Hollier and Peter Schwendinger for comments on the manuscript. Special thanks are due to Emmanuelle Werlen for entering the MHNG specimen information into the MHNG database. We are grateful to Ben Price for exporting data from the NHMUK database to facilitate searching, to Roberto Poggi for information about the holdings of the MCSN and to David Szymroszczyk for information about the holdings of the MIZW.

REFERENCES

Beccaloni G.W. 2014. Cockroach Species File Online. Version 5.0/5.0. Available at http://Cockroach.SpeciesFile.org (accessed 14.i.2020).

Hebard M. 1920. The Blattidae of Panama. *American Entomological Society Memoirs* 4: 1-148, pl. 1-6 .

Hebard M. 1925. Studies in the Dermaptera and Orthoptera of Ecuador. *Proceedings of the Academy of Natural Sciences of Philadelphia* 76: 109-248.

Hollier A., Hollier J. 2012. Henri de Saussure's expedition to Mexico and the West Indies (1854-56). *Antenna* 36(4): 231-238.

Hollier A., Hollier J. 2013. A re-evaluation of the nineteenth-century naturalist Henri de Saussure. *Archives of Natural History* 40(2): 302-319.

Hollier J.A. 2008. An annotated list of Malcolm Burr's Blattodea, Dermaptera and Orthoptera (Insecta) types in the collections of the Muséum d'histoire naturelle in Geneva. *Entomologist's monthly Magazine* 144: 157-162.

Hollier J., Heads S.W. 2014. The type specimens of Orthoptera described by American entomologists in the collection of the Muséum d'histoire naturelle de Genève. *Revue suisse de Zoologie* 121: 63-76.

Hollier J., Hollier A. 2018. Leo Zehntner, Swiss pioneer of tropical applied entomology. *Antenna* 42(2): 56-60.

Hollier J., Marshall J., Legendre F. 2020. An annotated list of the Blattodea (Insecta) described by Henri de Saussure. Part 1: the Corydiidae. *Revue suisse de Zoologie* 127(2): 341-248.

Maes J.-M., Estrada-Álvarez J., Sormani C.G. 2020. Catalogo ilustrado de las cucarachas (Blattodea) de Nicaragua. *Revista Nicaragüense de Entomología* 213: 3-108.

Poggi R. 2021. Catalogo dei tipi di Blattodei del Museo Civico di Storia Naturale "G. Doria" di Genova. *Annali del Museo Civico di Storia Naturale "G. Doria"* 114: 123-161.

Saussure H. de 1862. Orthoptera nova Americana (Diagnoses praeliminares). *Revue et Magasin de Zoologie Pure et Appliquée* 14: 163-171, 227-234.

Saussure H. de 1868. Orthoptera species novae aliquot. *Revue et Magasin de Zoologie Pure et Appliquée* 20: 97-101, 354-357.

Saussure H. de 1869. Mélanges Orthoptèrologiques. Fascicule II. Blattides et Phasmides. *Mémoires de la Société de Physique et de l'histoire naturelle de Genève* 20: 227-328.

Saussure H. de 1870. Famille des Blattides (pp. 1-123, plates 1-2). *In*: Milne Edwards H. (ed.). Mission Scientifique au Mexique et dans l'Amérique Centrale. Recherches Zoologiques 6 (section 1*). Imprimerie Imperial, Paris,* 533 pp., 8 pls.

Saussure H. de 1895. Esplorazione del Giuba e dei suoi affluenti, compiuta dal Cap. V. Bottego durante gli anni 1892-93 sotto gli auspicii della Societa Geographica Italiana. Risultati Zoologici V. Ortotteri. *Annali del Museo Civico di Storia Naturale di Genova* 35: 67-93.

Saussure H. de, Zehntner L. 1893. Blattidae (part) (pp. 13-104). *In*: Godman F.D., Salvin O. (eds). Biologia Centrali-Americana. Insecta Orthoptera (Orthoptera Genuina) Volume 1. *Porter, London,* 458 pp, 22 pls.

Shelford R.W.C. 1906. Studies of the Blattidae. I. Remarks on the sub-families Ectobiinae and Phyllodrominae. *Transactions of the Entomological Society of London* 2: 231-248.

Revue suisse de Zoologie (September 2022) 129(2): 309-322 ISSN 0035-418

Coleophora santonici Baldizzone & Takács (Lepidoptera, Coleophoridae), new species from Hungary bred from *Artemisia santonicum*

Giorgio Baldizzone[1,2*], Attila Takács[3], Csaba Szabóky[4] & Miklós Bozsó[5]

[1] *Via Manzoni, 24, I-14100 Asti, Italy; Muséum d'histoire naturelle de Genève, C.P. 6434, CH-1211 Geneva 6, Switzerland (Corresponding member); ORCID 0000-0001-8127-0843*
[2] *Contribution to the knowledge of Coleophoridae CLII*
[3] *Government Office of Fejér county, Major Department of Agriculture Plant Protection and Soil Conservation Department, Ország út 23, H-2481 Velence, Hungary; https://orcid.org/ 0000-0003-3427-538X*
[4] *Bécsi út, 88, H-1034 Budapest, Hungary; https://orcid.org/ 0000-0002-1290-0976*
[5] *Budaörsi út, 141-145, H-1118 Budapest, Hungary; https://orcid.org/ 0000-0003-1285-636X*
* *Corresponding author: baldizzonegiorgio@gmail.com*

Abstract: The work describes *Coleophora santonici* Baldizzone & Takács, sp. nov., a species bred from *Artemisia santonicum* L., 1753 (Asteraceae) in Hungary. The new species belongs to the *C. ptarmicia* Walsingham, 1910 group based on shared features of the genitalia, and is most similar to *C. santolinella* Constant, 1890. Biological data on the life cycle, larval case and habitats of the species are provided and illustrated. COI barcode sequences were also obtained for *Coleophora santonici* and loaded into the BOLD System and NCBI gene bank.

Keywords: Asteraceae - *Coleophora santolinella* - Cytochrome oxydase 1 barcode - host plant.

INTRODUCTION

Currently, more than 1540 species of Coleophoridae are known in the world (Baldizzone, unpublished data). Of this total, about 600 are found in Europe, where this family of Lepidoptera has always attracted the attention of researchers owing in particular to its larval cycle, which normally occurs in a mobile case. However, even though the European *Coleophora* fauna is remarkably well known compared to that of other continents, many species still remain to be described on the basis of material already preserved in museums and private collections. It is expected that others will be discovered with an increase in research, in particular with breeding, a practice that often makes it possible to find species that are rarely encountered in nature, both through direct harvesting and with the use of lamps and light traps.

Hungary is located in the Pannonian biogeographical area within the Palearctic Region. Several *Coleophora* species have been described from this region in the last 70 years (Gozmány, 1954, 1955; Baldizzone, 1983). A total of 211 species of Coleophoridae have been recorded in Hungary to date. Of these, one belongs to the genus *Augasma* Herrich-Schäffer, 1853 and 210 belong to the genus *Coleophora* Hübner, 1822 (Szabóky & Takács, 2021). Several *Coleophora* species have been discovered in Hungary during the last two decades, e.g. *C. impalella* Toll, 1961, *C. lessinica* Baldizzone, 1980, *C. nigridorsella* Amsel, 1935, *C. jaernaensis* Björklund & Palmqvist, 2002 (Hübner, 1822; Herrich-Schäffer, 1853; Baldizzone, 1980; Amsel, 1935; Björklund & Palmqvist, 2002; Baldizzone & Tokár, 2008; Buschmann *et al.,* 2014; Buschmann & Pastorális, 2018; Szabóky & Takács, 2021).

The Hungarian authors of this paper recently bred a small-sized *Coleophora* species belonging to the *C. ptarmicia* Walsingham, 1910 (Walsingham, 1910) species group from *Artemisia santonicum* L., 1753 (Asteraceae). Studies of the external morphology, genital structures and molecular aspects (COI), carried out in collaboration with the first author, have shown that it represents a new species, which is described below.

MATERIAL AND METHODS

Field work and rearings were conducted in Hungary. Larvae of the new species were reared and overwintered on *Artemisia santonicum* plants removed from the field and planted in the garden of Attila Takács. All larval cases

Manuscript accepted 20.05.2022
DOI: 10.35929/RSZ.0078

were kept in separate tulle bags attached to the plants in order to prevent escape. A few days before the expected time of emergence the cases were relocated to separate plastic vials, where a suitable degree of humidity was maintained.

All the material was collected or observed by the Hungarian authors. The holotype and three paratypes are to be deposited in the Hungarian Natural History Museum, Budapest. The remaining paratypes are deposited in the research collections of Baldizzone (Asti, Italy), Takács (Velence, Hungary) and Szabóky (Budapest, Hungary).

The Euparal slide mounts of dissected genitalia were photographed with a Bresser 5.0 camera attached to a Bresser BioScienze 40-1000x trinocular microscope, using a Leitz PL Fluotar 6.3 / 0.20 objective. The CombineZP program was used for stacking layers into deep-focus images and the resulting images were edited in Corel PaintShop Pro. Images of adults and larval cases were photographed with a Canon 450 D camera attached to a Carl Zeiss Stemi-2000 binocular stereomicroscope; images were edited with Adobe Photosop CS6. Morphological terms follow Baldizzone (2019).

For DNA extraction specimens were killed and stored in 70% alcohol (Table 1). DNA was isolated with Quick-DNA Tissue/Insect Miniprep Kit (Zymo Research) according to the recommended protocol of the manufacturer. Amplification of the COI barcode region was performed with the primers LCO-1490 and HCO-2198 (Folmer *et al.,* 1994). The PCR products were purified using the USB ExoSAP-IT® PCR Product Clean-Up reagent (Affymetrix) and amplicons were sequenced bidirectionally (BaseClear B.V., the Netherlands). The new sequences were assembled with Staden Package 2.0.0b9. Sequences were inspected and translated in translate tool of ExPASy Bioinformatics Resource Portal (Artimo *et al.* 2012) to verify that they were free of stop codons.

One of the aims of our molecular study was to explore the genetic distances between these Hungarian specimens and all available morphologically similar *Coleophora* taxa from the BOLD System database based on their CO1 barcode regions. We used sequences of *C. ptarmicia* Walsingham, 1910, *C. santolinella* Constant, 1890, *C. solidaginella* (Staudinger, 1859) and *Coleophora conyzae* Zeller, 1868 for our analysis. The multiple sequence alignment was carried out by ClustalW (Larkin *et al.,* 2007), with default parameters with these downloaded gene sequences. The most appropriate model of nucleotid substitution was determined with MEGA7 (Kumar *et al.,* 2016) under the Bayesian Information Criterion (BIC). The Tamura-3-parameter model with Gamma Distribution (T92+G) (Tamura, 1992) was selected for our phylogenetic reconstruction and distance analysis. Phylogenetic tree was constructed with the Neighbour-Joining (NJ) method (Saitou & Nei, 1987) implemented in Mega 7 with the default initial rearrangement settings. To obtain an estimate of the support for each node, a bootstrap analysis using 1000 replicates was performed. Bootstrap support is given on appropriate clades in the NJ tree.

Abbreviations

AT = Attila Takács, Velence, Hungary.
Bldz = Giorgio Baldizzone, Asti, Italy.
CsSz = Csaba Szabóky, Budapest, Hungary.
HNHM = Hungarian Natural History Museum, Budapest, Hungary.
IgR = Ignác Richter, Malá Causa 289, Slovakia.
PG = genital preparation.

RESULTS AND DISCUSSION

Taxonomy

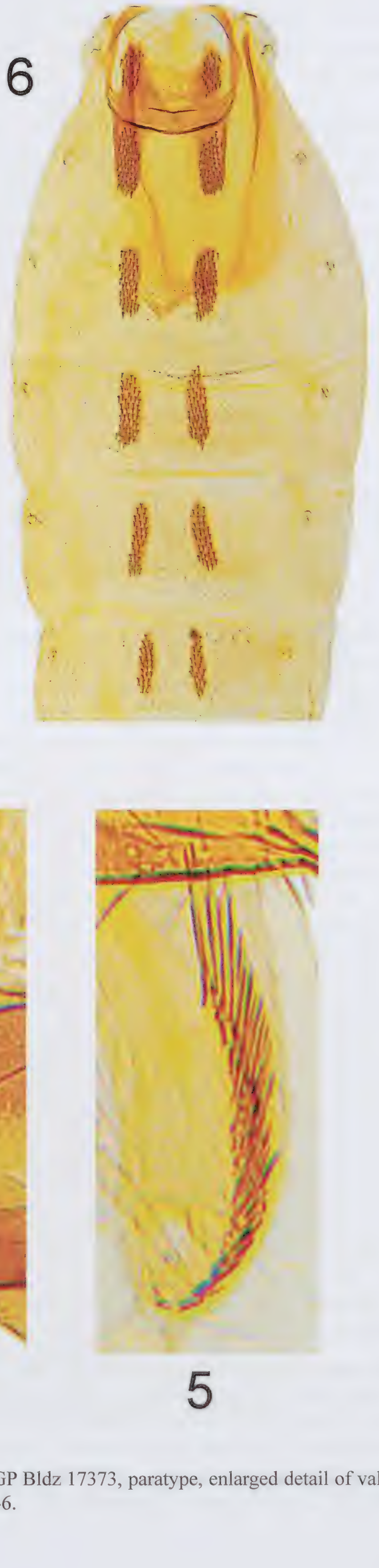
***Coleophora santonici* Baldizzone & Takács sp. nov.**

Figs 1-9, 18-21

Holotype: ♂, (PG Bldz 17180) Hungary, Fejér megye, Pákozd, [47°12'59"N, 18°34'15"E]) 26.06.2020, light trap, leg. A. Takács, deposited in HNHM.

Paratypes: 65 ♂, 17 ♀, all from Hungary: 1 ♀, Fejér megye, Sárszentágota [46°58'08.0"N, 18°33'07.4"E] 10.06.2020 light trap, leg. A. Takács. – 1 ♂ (PG Bldz 17175), same locality, 25.06.2020, ex larva *Artemisia santonicum*, leg. A. Takács. – 1 ♂ (PG Bldz 17373), 1 ♀ (PG Bldz 17370), same locality, ex larva *Artemisia santonicum*, leg. A. Takács. – 1 ♂ (PG Bldz 17371), same locality, 5.06.2021, leg. A. Takács. – 1 ♂, 1 ♀ (PG Bldz 17372), same locality, 8.06.2021, ex larva *Artemisia santonicum*, leg. A. Takács. – 3 ♂,

Figs 1-2. Adults of *C. santonici* sp. nov. (1) Holotype ♂. (2) Paratype. ♂ A. Takács" (photos by A. Takács).



Figs 3-6. Male genitalia of *C. santonici* sp. nov. (3) GP Bldz 17180, holotype. (4) GP Bldz 17373, paratype, enlarged detail of valva and phallotheca. (5) Enlarged detail of cornuti. (6) Abdominal segments 1-6.

Pákozd, 8.VI.2021, ex larva *Artemisia santonicum*, leg. A. Takács; in coll. Baldizzone, Asti. 1 ♀, Fejér megye, Pákozd, (PG IgR30786), 26.06.2020, light trap, leg. A. Takács, det. I. Richter as *Coleophora* sp. – 1 ♀, same locality, 1.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 2 ♂, 1 ♀, same locality, 8.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♀, same locality 11.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 3 ♂, 4 ♀, same locality, 19.05.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♂, Fejér megye, Sárszentágota, 25.06.2020, ex larva *Artemisia santonicum*, leg. A. Takács. – 1 ♂, same locality, 26.06.2020, ex larva *Artemisia santonicum*, leg. A. Takács. – 2 ♂, same locality, 5.05.2021, ex larva *Artemisia santonicum*, leg. A. Takács. – 5 ♂, 1 ♀, same locality, 5.06.2021, ex larva *Artemisia santonicum*, leg. A. Takács. – 2 ♂, 3 ♀, same locality, 6.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♂, same locality, 7.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♂, same locality, 8.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♂, same locality, (PG IgR31784), 22.06.2021, light trap, leg. A. Takács, det. I. Richter as *Coleophora ptarmicia* Walsingham, 1910. – 1 ♂, Békés megye, Bélmegyer, fáspuszta, [46°53'41.8"N, 21°11'07.4"E] 03.06. 2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♀, same locality, 18.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács; in coll. A. Takács, Velence. – 3 ♂, Fejér megye, Sárszentágota, 10.06.2020, ex larva, *Artemisia santonicum*, leg. A. Takács. – 6 ♂, Fejér megye, Pákozd, 15.6.2020, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♂ (PG IgR30942), same locality, 15.6.2020, ex larva, *Artemisia santonicum*, leg. A. Takács, det. I. Richter as *Coleophora ptarmicia* Walsingham, 1910. – 1 ♂, same locality, 16.06.2020, ex larva, *Artemisia santonicum*, leg. A. Takács. – 7 ♂, same locality, 29.05.2021, ex larva, *Artemisia santonicum*, leg. Cs. Szabóky. – 5 ♂, same locality, 4.06.2021, ex larva, *Artemisia santonicum*, leg. Cs. Szabóky. – 6 ♂, same locality, 6.06.2021, ex larva, *Artemisia santonicum*, leg. Cs. Szabóky. – 4 ♂, Békés megye, Bélmegyer, fáspuszta, 29.05. 2021, ex larva, *Artemisia santonicum*, leg. Cs. Szabóky. – 2 ♂, same locality, 4.06.2021, ex larva, *Artemisia santonicum*, leg. Cs. Szabóky; 1 ♂, same locality, 5.06.2021, ex larva, *Artemisia santonicum*, leg. Cs. Szabóky. – 2 ♂, Jász-Nagykun-Szolnok megye, Tiszafüred, [47°32'24.8"N, 20°52'33.6"E] 8.06.2021, ex larva, *Artemisia santonicum*, leg. A. Patalenszki; in coll. Cs. Szabóky, Budapest.

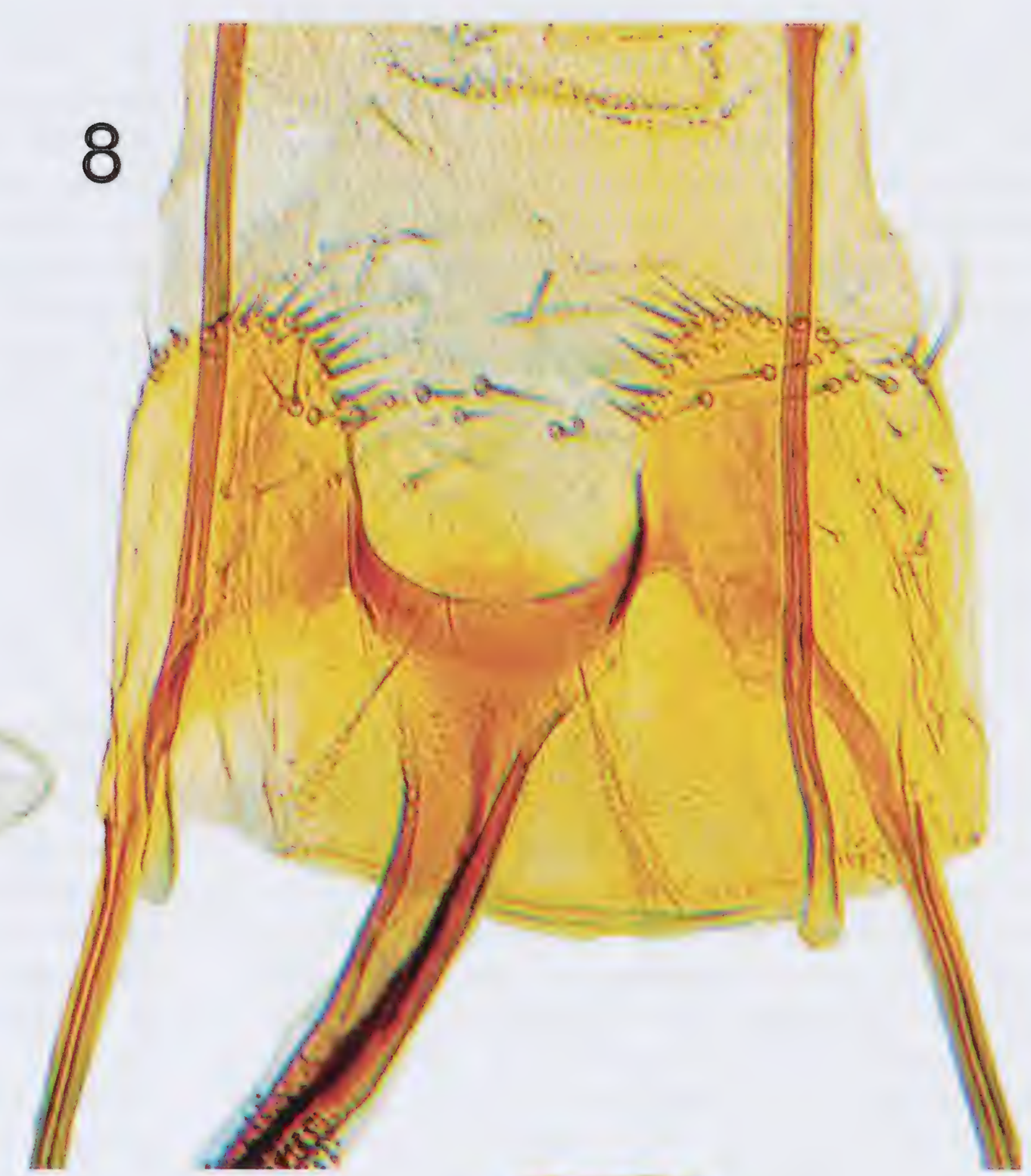
Diagnosis: The species is characterized by the forewing with a mixture of brown and white streaks, the brown ones being more or less positioned along the veins whereas the white streaks are mostly in the interveinal areas. The genital structure of the male is similar to that of *C. santolinella* Constant, 1890 (Figs 10-13). The tegumen is slightly longer and the pedunculus is a little more dilated on the outside; the horn-shaped protuberance in the dorsal angle of the sacculus is slightly smaller and sharper; the cornuti are much more numerous and more regular in shape than those of *C. santolinella*, where there is a marked difference in the length of the 2-3 apical ones which are much longer than the others. In the female genitalia of *C. santonici* sp. nov., the sterigma is longer and narrower than that of *C. santolinella* (Fig. 14-16); the ostium bursae is slightly smaller; the spinulate part of the ductus bursae and the medial line are shorter; the proximal part of the ductus is thinner and more sclerified; the corpus bursae is oval and not elongated; and the signum is much more irregular and less wide in the laminar part and much larger and longer in the pedunculate part.

Description: Wingspan 10.5-11.5 mm (n=all 83 specimens). Head white, suffused beige on dorsum, frons beige. Antenna: scape beige on outer side, brown on inner side, with tuft of short erect scales; flagellum white, ringed white and light beige on distal 1/3. Labial palpus greyish brown, white on the dorsal surface, the third article, dark brown at the apex, about as long as the second. Proboscis of normal shape. Thorax white, beige in middle. Tegula white, almost completely suffused beige. Forewing colour a mixture of brown and white streaks, along costa, radial veins, central part, where the wide streak is divided by a thin, longitudinal, beige line, along dorsum; costal fringes white at base, brownish grey in middle, white at apex; dorsal fringes grey with white basal part. Female forewing slightly more lanceolate than that of male. Hindwing grey, fringes light grey. Abdomen white.

Abdominal structures (Figs 6, 9): Anterior lateral struts about 4 times as long as posterior ones. Transverse strut thin and linear on proximal edge, curved and less sclerotized in middle on distal edge. Tergal disks (3rd tergite) length about 4 times their width, covered with about 65 small conical spines.

Male genitalia (Figs 3-5): Gnathos knob globular. Tegumen medially constricted, pedunculus expanded externally. Transtilla short, thin and curved, joined in middle. Valvula suboval, bristling with long setae in middle and short setae on curved lower edge. Cucullus long and slender, slightly thinner at base. Sacculus broad and low, with slightly curved ventral edge, short pointed protuberance in ventral angle and curved, pointed protuberance just over half length of cucullus in dorsal angle. Phallotheca conical, more sclerotized laterally. Cornuti 12-14, gathered at base in a formation about half as long as vesica, spines of progressively greater length in direction of phallotheca.

Female genitalia (Figs 7-8): Papillae anales elongate oval. Apophyses posteriores about twice as long as anteriores. Sterigma trapezoidal, twice as wide as high, more sclerified in central area around ostium bursae,



Figs 7-9. Female genitalia of *C. santonici* sp. nov. (7) GP Bldz 17370, paratype. (8) GP Bldz 17372, paratype, enlarged detail of sterigma, ostium bursae and colliculum. (9) Abdominal segments 1-5.

distal edge deeply hollowed by sinus vaginalis, with many short and robust setae. Ostium bursae broad, oval, opening in middle of sterigma. Colliculum cup-shaped, long, wider in distal part, narrowed in proximal one, strongly sclerotized on external edges with a medial line. Ductus bursae long: distal part about 4 times length of sterigma, covered with small spines, except in anterior transparent and curved section where medial line begins; proximal part of ductus membranous, finely spiculate and widened towards corpus bursae; corpus bursae large, oval with one large, leaf-shaped signum with laminar part with an irregular, jagged edge and a long and robust pedunculate part.

Remarks: The *Coleophora ptarmicia* group is characterized by genital structures that are quite similar, especially in the male, while in the females the differences are more pronounced. In Europe *C. ptarmicia* is the most widespread species (Baldizzone, 2019). *Coleophora santolinella* is distributed only in part of the western Mediterranean area. In Asia, *C. paraptarmica* Toll & Amsel, 1967, described from a male from Afghanistan, is similar in genitalia to the European species, with minor differences. Falkovitsh (1973) published a few lines on the presence *C. paraptarmica* in Turkmenistan and on the plant from which he had bred it, *Artemisia turanica* Krasch., along with a drawing of the larval case, which is similar to that of *C. ptarmicia*. The first author (GB) had received as a gift a pair of specimens *C. paraptarmica* from Falkovitsh and subsequently, on the basis of their genitalia structures, in particular that of the female, had identified numerous specimens of this species from Afghanistan, Turkey, Pakistan, Iran and Syria (Baldizzone, 1994). Wolfgang Glaser had also bred specimens (in part in coll. Baldizzone) from Turkey on *Artemisia maritima* L., attributing them to this species. In the light of current knowledge, including genetic studies which have highlighted a good number of probably undescribed species from Russia, the Near and Middle East, Central Asia, all determinations of "*paraptarmica*" need to be reconsidered.

Molecular diagnosis: Interspecific distances ranged from 0.085 to 0.166 with *C. ptarmicia* and *C. conyzae*, respectively (Table 2). The results of our molecular analysis correlate well with morphological and genital features and support the status of *C. santonici* as a distinct, new species. It is worth noting that *C. ptarmicia* displayed a remarkable intraspecific variation (0.104) compared to another geographically widespread species, *C. conyzae* (0.008) (Table 2). Furthermore, its recovered haplotypes did not form a monophyletic cluster (Fig. 17). The genetic distance between the two haplotypes was 0.098 (Table 3). The genetic distance between the Russian haplotype of *C. ptarmicia* and the Hungarian haplotypes of *C. santonici* - which are located in the same clade - was 0.035 and 0.037, respectively. A similar intraspecific genetic distance was observed for the haplotypes of *C. santolinella* (0.029). Moreover, it should be noted that the genetic distances between the *C. solidaginella* and *C. conyzae* haplotypes also seemed to be very low (pairwise distance: <0.001-0.009, Table 3). These results

Table 1. *Coleophora santonici* specimens from Hungary used for molecular analyses. Host plant: *Artemisia santonicum*.

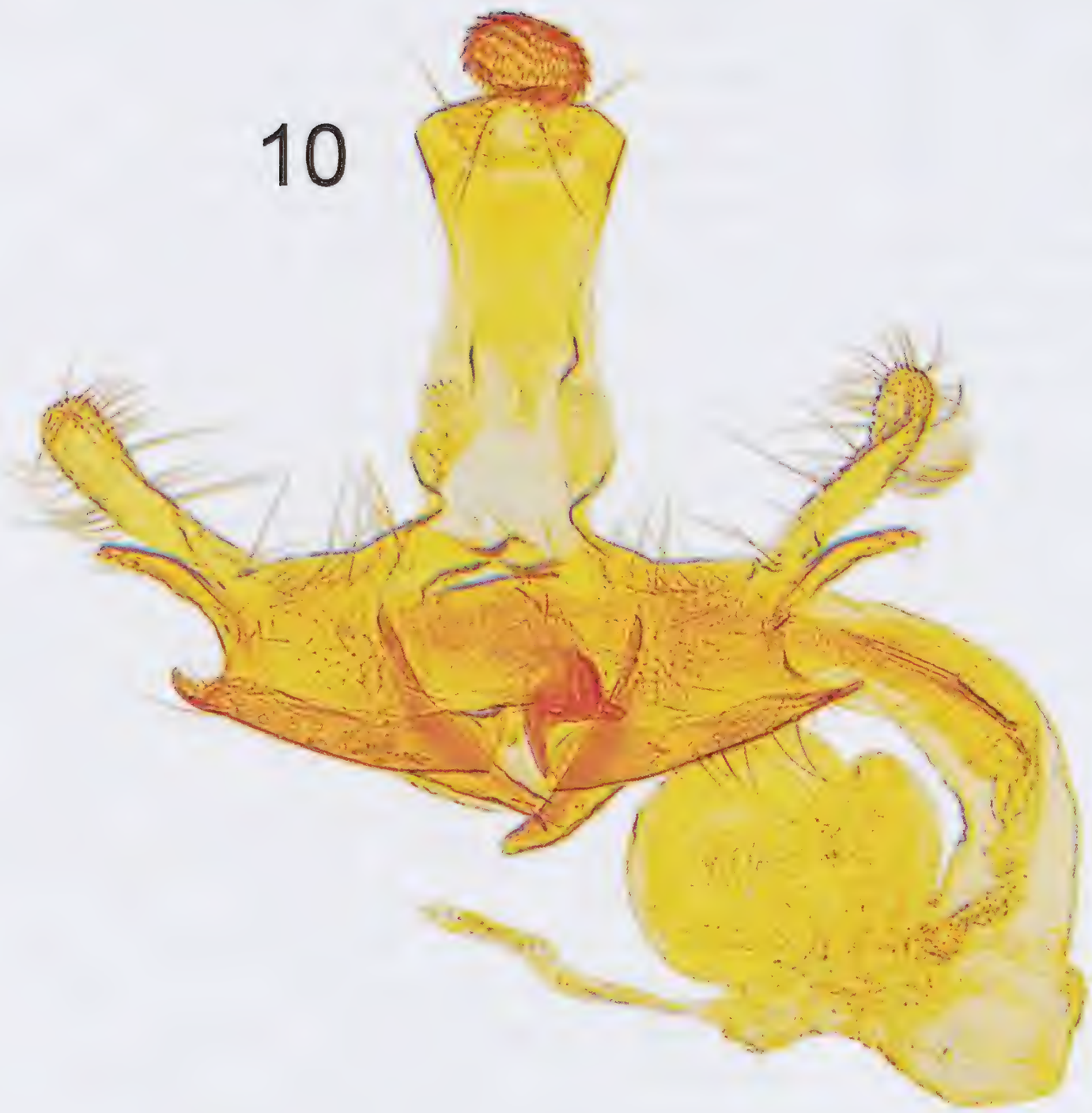
Locality	Longitude	Latitude	Date of collection	Collector	NCBI GenBank code	Stage
Sárszentágota	46°58'07"N	18°33'07"E	17.10.2020	A. Takács	MZ664316	larva
Pákozd	47°12'59"N	18°34'15"E	26.05.2021	A. Takács	OK335987	larva
Sárszentágota	46°58'07"N	18°33'07"E	05.06.2021	A. Takács	OM420279	ex larva, imago
Bélmegyer	46°53'41"N	21°11'07"E	18.06.2021	A. Takács	OM420280	ex larva imago
Pákozd	47°12'59"N	18°34'15"E	01.06.2021	A. Takács	OM420275	ex larva, imago

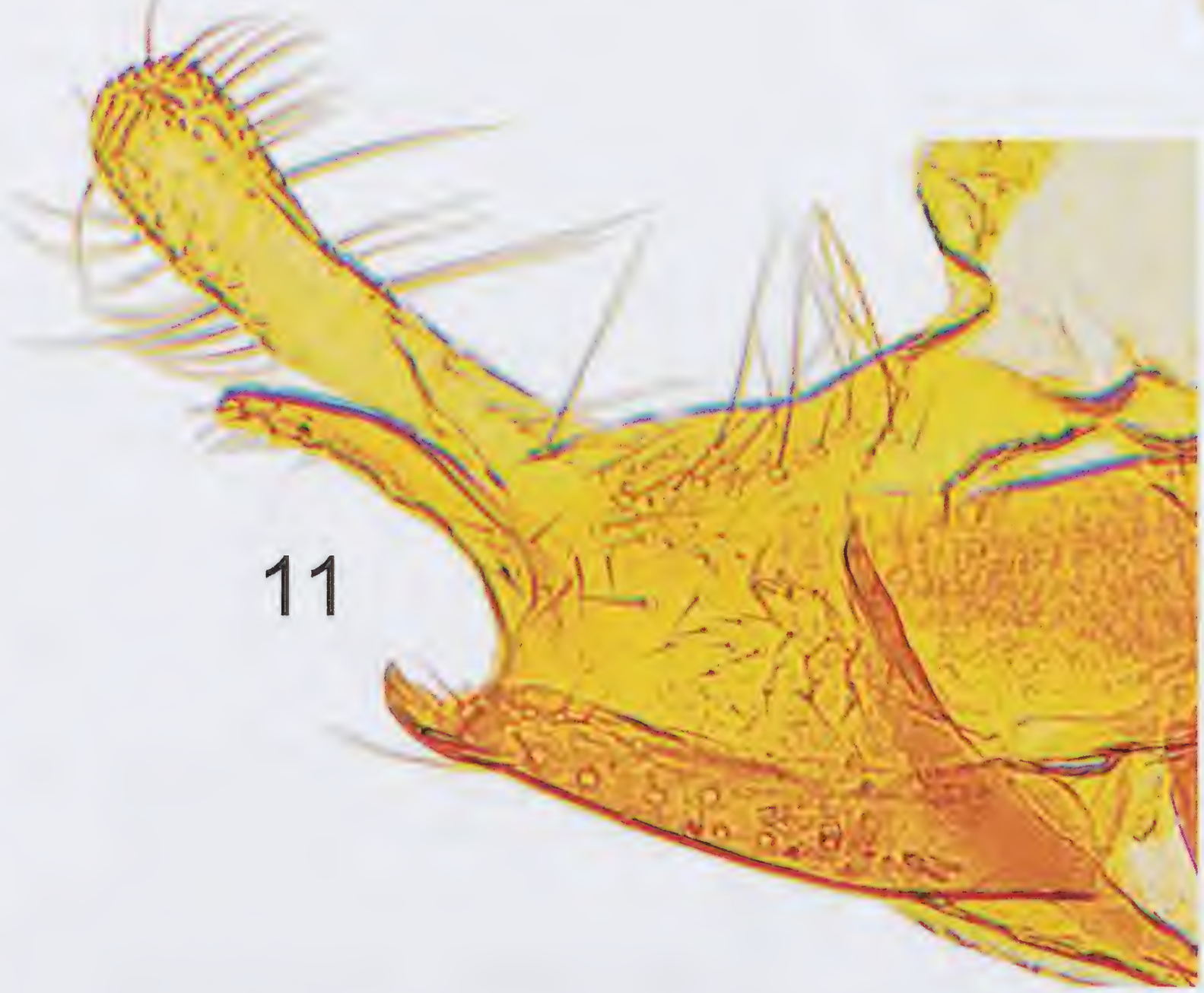
Table 2. Interspecific T92+G divergences between *C. santonici* and four similar species (in genitalia morphology), based on the analysed section of the COI gene sequence. The number of examined specimens are in parentheses. Maximum intraspecific variations are given in diagonal grey cells.

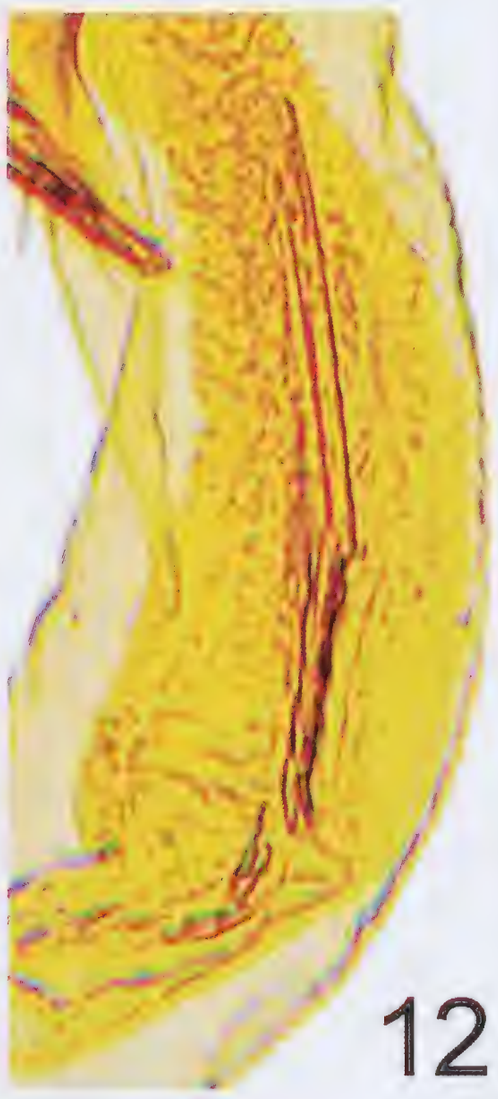
	santonici	*ptarmicia*	*santolinella*	*solidaginella*	*conyzae*
santonici sp. nov. (5)	0.002				
ptarmicia (2)	0.085	0.104			
santolinella (2)	0.144	0.125	0.029		
solidaginella (1)	0.150	0.153	0.164	-	
conyzae (7)	0.166	0.164	0.181	0.006	0.008

Table 3. Pairwise distances between *Coleophora* haplotypes based on the analysed section of the COI gene sequence (T92+G).

	OK335987	MZ664316	JF847408	MPEA323-08	KX048812	MPEA603-08	JF847405	ELACA236-10	DEEUR260-11	LNEL163-06	LNEL161-06	ELACA237-10
santonici sp.nov. (OK335987, Hungary)												
santonici sp.nov. (MZ664316, Hungary)	0.002											
ptarmicia (JF847408, Russia)	0.037	0.035										
ptarmicia (MPEA323-08, Italy)	0.126	0.122	0.098									
santolinella (KX048812, Spain)	0.145	0.141	0.123	0.123								
santolinella (MPEA603-08, France)	0.126	0.122	0.106	0.114	0.029							
solidaginella (JF847405, Spain)	0.141	0.137	0.137	0.146	0.152	0.151						
conyzae (ELACA236-10, Sweden)	0.160	0.155	0.155	0.155	0.172	0.170	0.007					
conyzae (DEEUR260-11, Austria)	0.160	0.155	0.155	0.155	0.172	0.170	0.007	0.007				
conyzae (LNEL163-06, Italy)	0.160	0.155	0.156	0.155	0.172	0.171	0.007	0.007	0.004			
conyzae (LNEL161-06, Italy)	0.165	0.160	0.161	0.160	0.177	0.176	0.009	0.009	0.002	0.002		
conyzae (ELACA237-10, Spain)	0.141	0.137	0.137	0.146	0.152	0.151	<0.001	0.007	0.007	0.007	0.009	
conyzae (GBMIN27228-13)	0.146	0.141	0.142	0.141	0.156	0.155	0.004	0.011	0.011	0.011	0.013	0.004







Figs 10-13. Male genitalia of *C. santolinella*. (10) GP Bldz 17444, Sardinia, Aritzo, 1200 m, ex larva *Santolina*, 10.VII.1978, leg. Hartig, coll. Baldizzone. (11) Enlarged detail of valva and phallotheca. (12) Enlarged detail of cornuti. (13) Abdominal segments 1-5.

Figs 14-16. Female genitalia of *C. santolinella*. (14) GP Bldz 13577, Sardinia, Domusnovas, Sa Duchessa, 350 m, 2.VII.2004, at light, leg., coll. Baldizzone. (15) Enlarged detail of sterigma, ostium bursae and colliculum. (16) Abdominal segments 1-5.

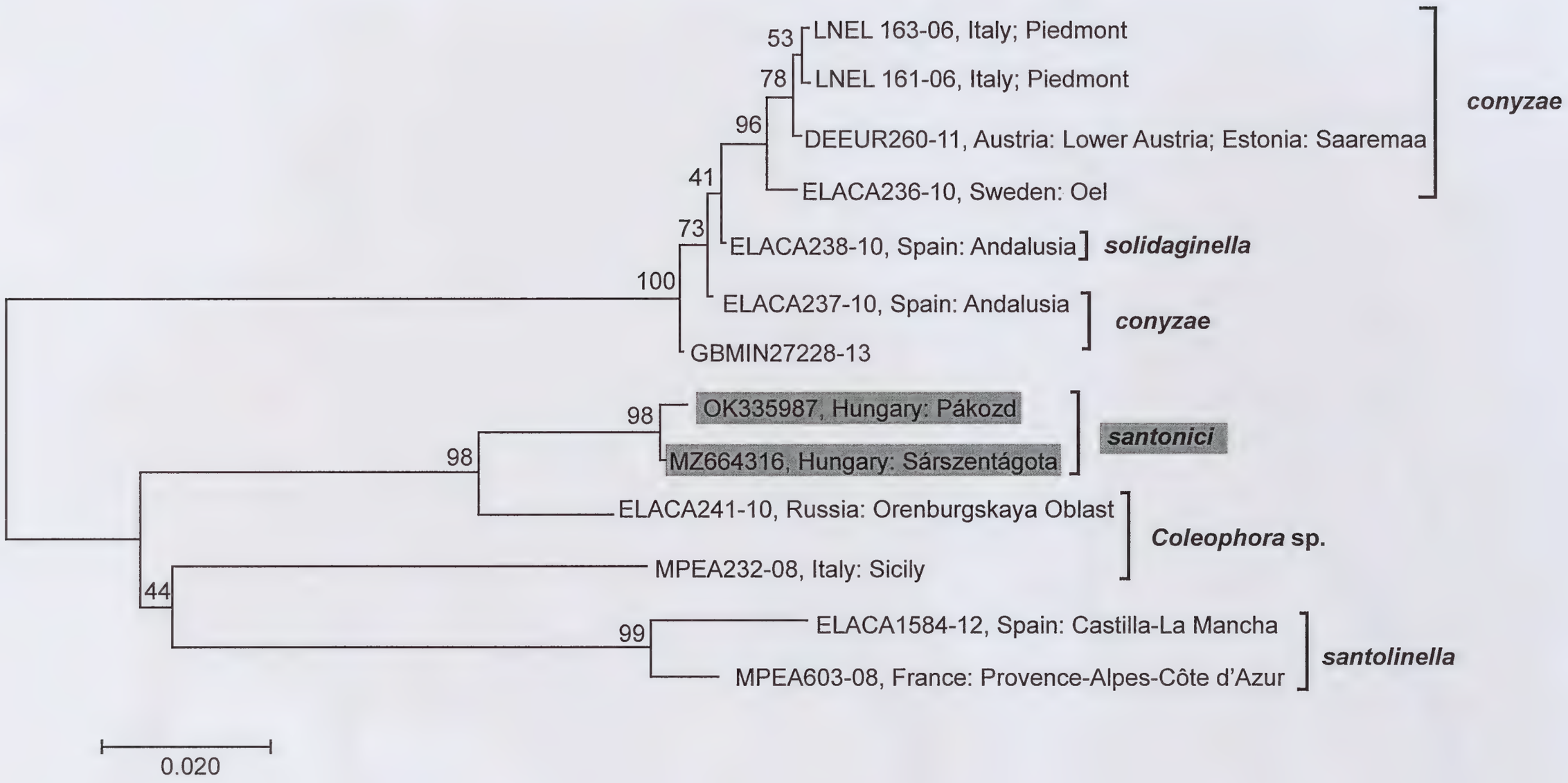


Fig. 17. Neighbor-joining tree of examined *Coleophora* specimens. Scale bar indicates 2% divergence of nucleotide substitutions.

may suggest that the species status of these specimens should be revised.

Bionomy: The host plant is *Artemisia santonicum*. The larvae hatch from their eggs in late September and early October, making a 2 mm case from the leaves of the host plant until winter (Fig. 18). The larvae overwinter in the L1 stage at the base of the host plant. In spring, the larvae continue to build their cases from chewed fresh leaves (Fig. 19). The overwintering case is dark brown. In spring the larva enlarges its case, which becomes fluffy, silvery bronze. The L2 case is 4 mm, the L3 size is 6 mm (Fig. 20), and the L5 size is 8-9 mm. The mature larva climbs to a relatively tall plant and attaches the case to it, for pupation (Fig. 21). The mouth of the case is at a 40° angle to the longitudinal axis of the case. The anal opening is bivalved.

The pupal stage lasts two weeks. In this period, the cases are easy to find. Adults fly from late May to late June; they are diurnal, but they are also attracted to the lamp.

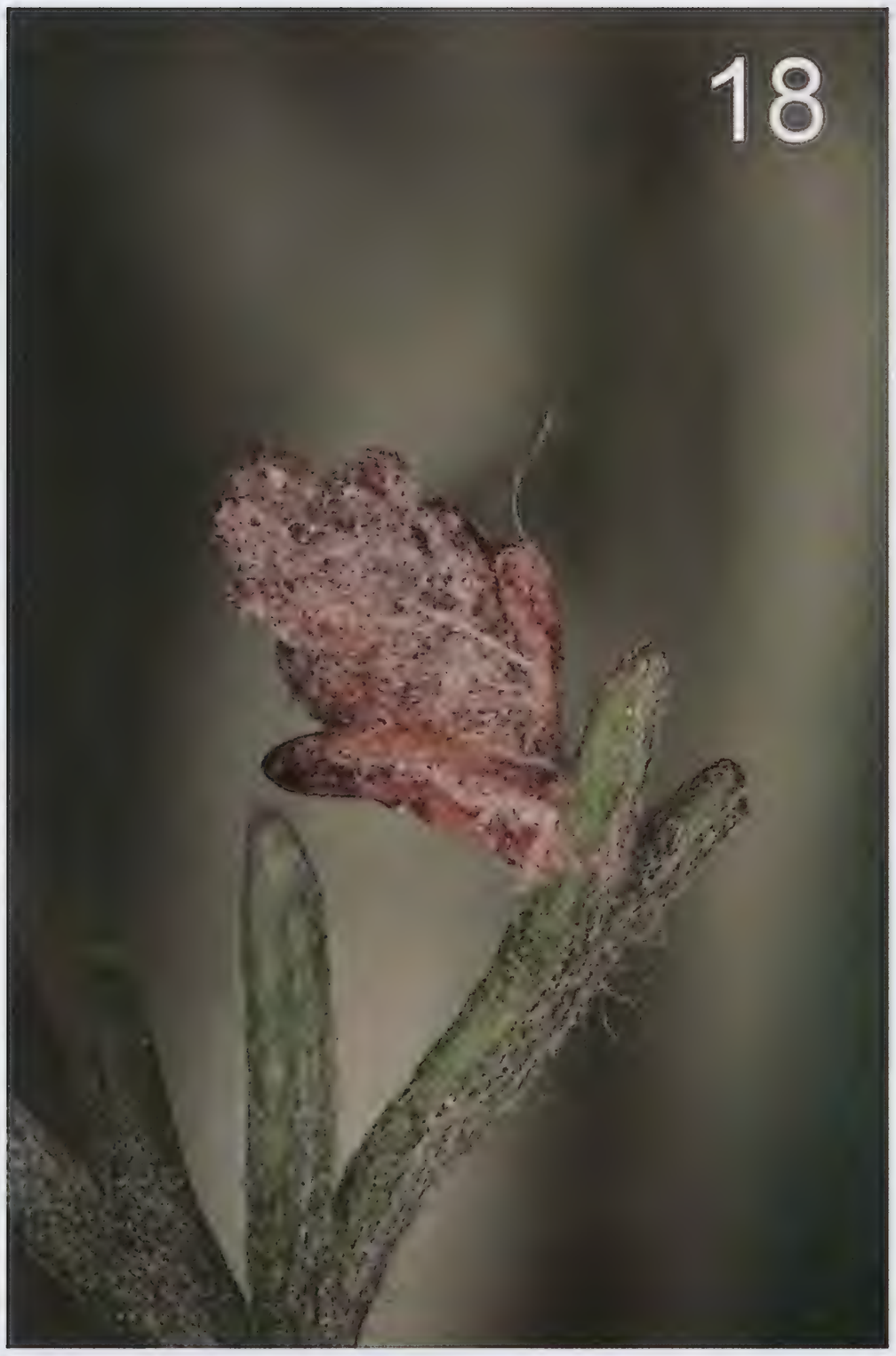
A total of 80 adults of *C. santonici* emerged from the cases grown on *Artemisia santonicum* and three specimens were captured with light traps, resulting in a total of 83 specimens.

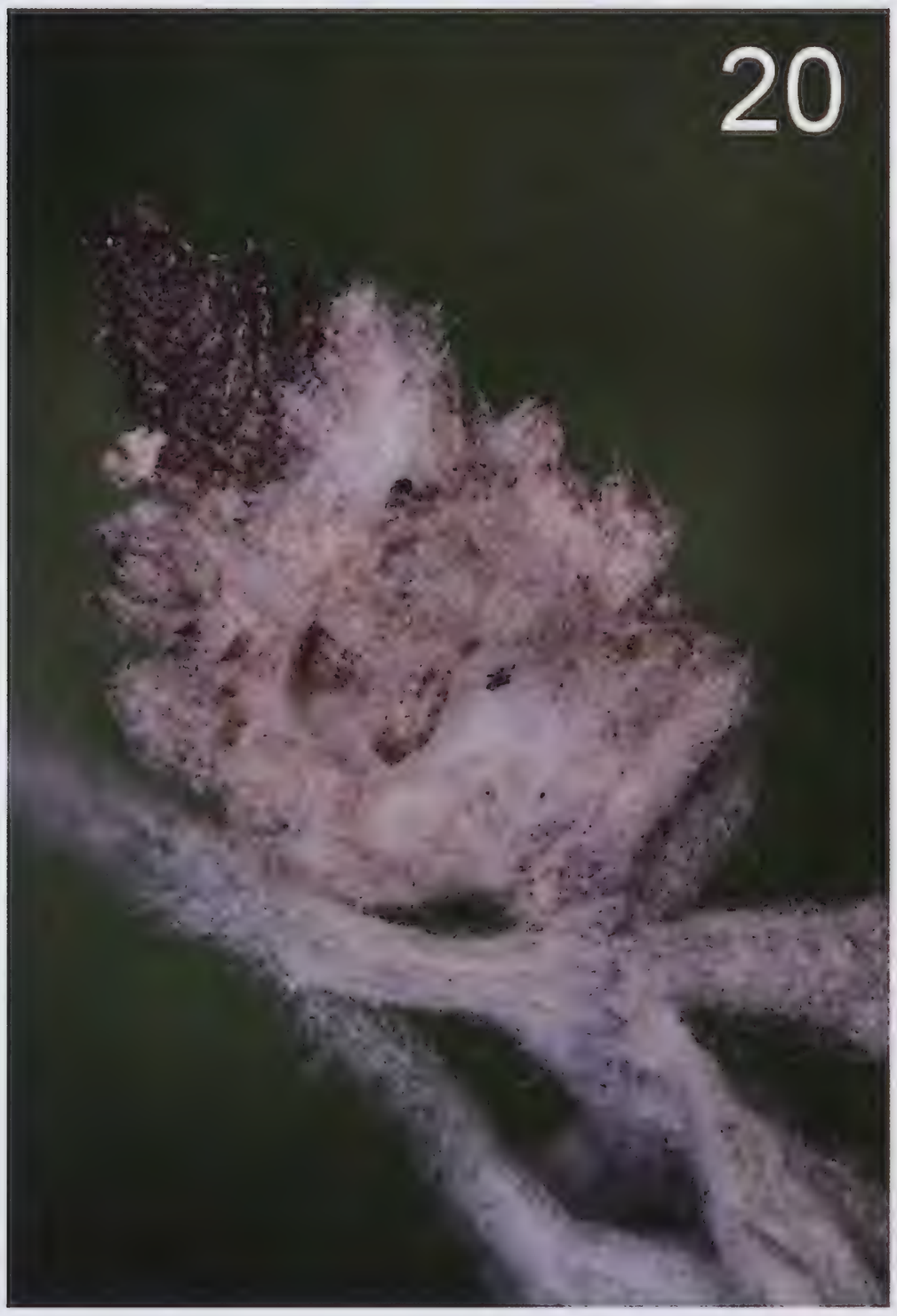
The parasitoids that emerged from a few cases of *Coleophora santonici* have been identified as members of the families Braconidae, Eulophidae (*Tetrastichus* sp.), and Ichneumonidae, and the superfamily Chalcidoidea (Hymenoptera). All specimens are under study by specialists and to be deposited in the HNHM.

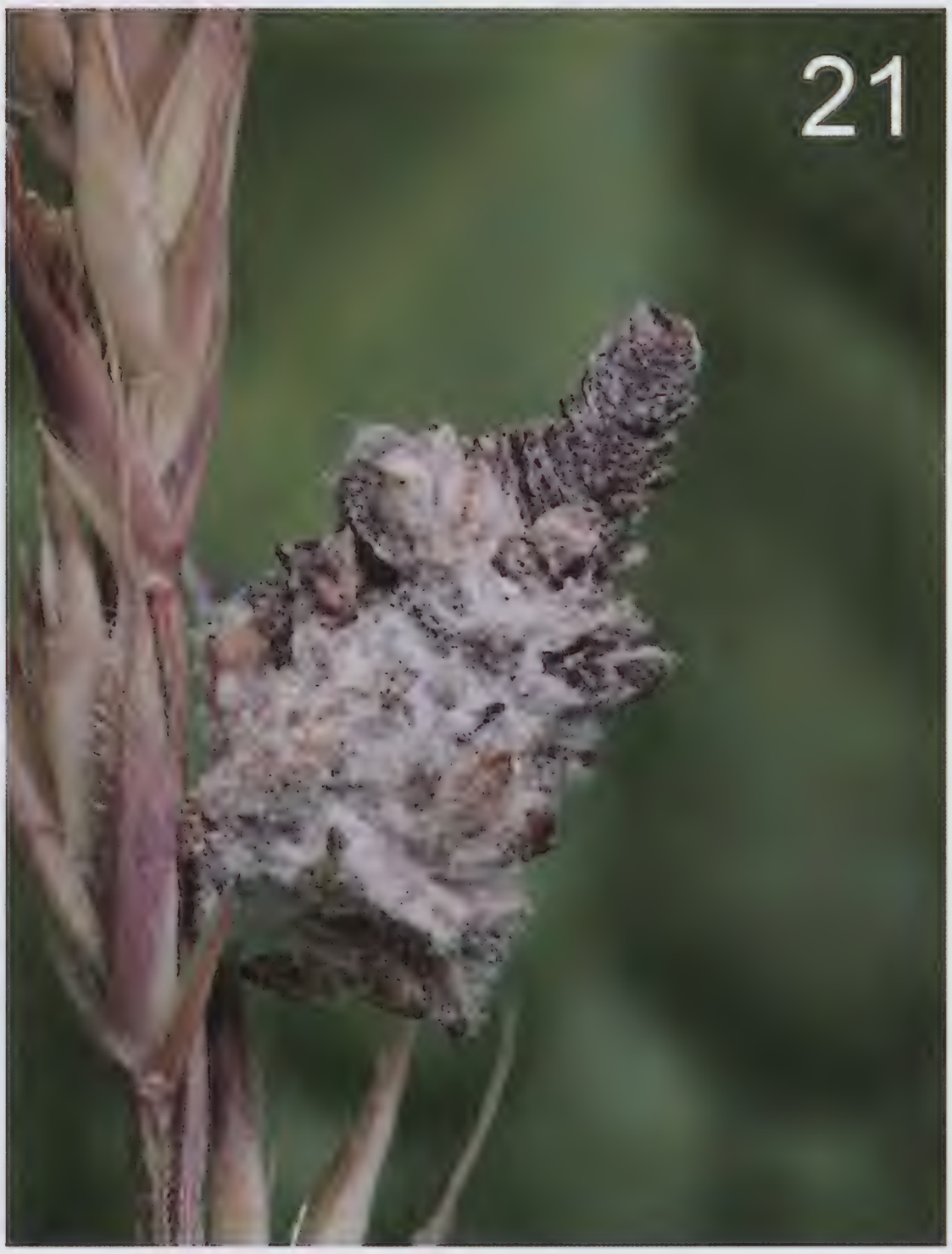
Distribution: The species has been collected only in Hungary. The description of the various habitats follows. All known habitats of *Coleophora santonici* are characterized by the salt steppe. The main association plant species is *Artemisia santonicum*. All sites are characterized by mosaicism and extreme rainfall and temperature fluctuations. The habitats are typically short grass worm steppes, with small patches of annual halophytic communities on saline plains, and mixed grassland meadow patches on fertile soil.

The habitat at Pákozd and Sárszentágota (Figs 22a, b): The first specimens of this species were trapped in an Artemisia salt steppe habitat near the village of Sárszentágota on June 12, 2020. The species was also found in the vicinity of Pákozd near Lake Velence on the same day. The habitats at both locations are characterized by short grass steppe on alkaline, solonetzic and solonchak soils. The vegetation is short (14-40 cm) and rather sparse with variable (30-80 %) ground cover. The variable soil conditions render the vegetation spatially heterogeneous. The dominant community is wormwood steppe, which is interspersed with patches of saline meadow and annual halophytic communities. The dominant plant species at both locations is *Artemisia santonicum* (Lendvai, 2021).

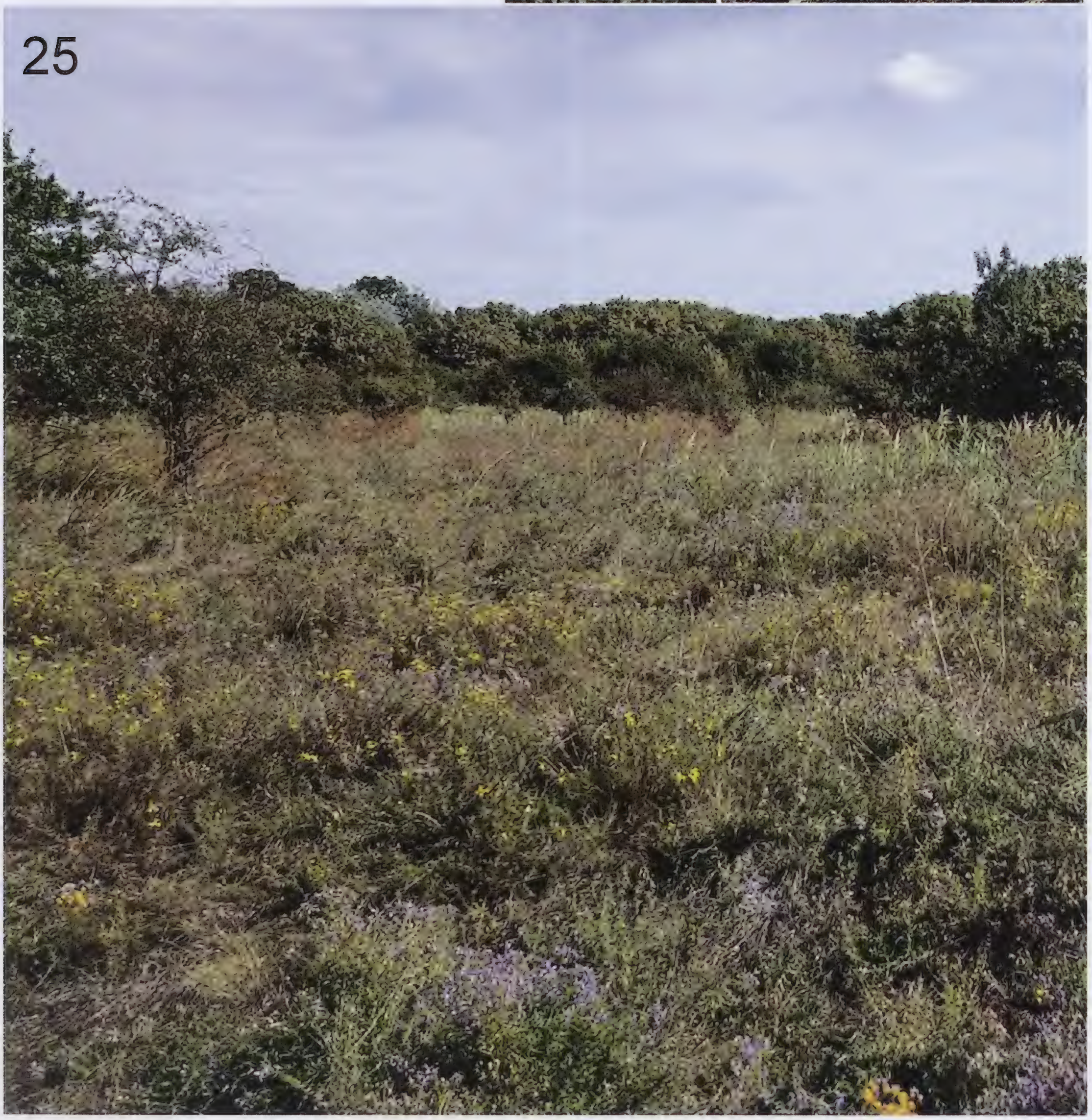
The habitat at Csanádalberti (Száraz-ér), Királyhegyes-Csikóspuszta (Blaskovics kripta), and Kosár-hát near Tiszafüred (Figs 22c, d, e): The habitat at Királyhegyes-Csikóspuszta (Blaskovics kripta) is overgrazed and thus degraded. About 70% of the habitat is invaded by *Phragmites australis* (Cav.) Trin. ex Steud., while the rest is dominated by a short grass steppe community of *Artemisia santonicum* and *Festuca valesiaca* Schleich. ex Gaudin s.l. that has developed on alkaline soils. The







Figs 18-21. Larval cases of *C. santonici* sp. nov. in progressive evolutionary stages. (18) L1 case before overwintering: Sárszentágota, 17.10.2020, 3 mm. (19) L2 case after overwintering: Sárszentágota, 4.04.2020, 4 mm. (20) L3 case: Sárszentágota, 8.04.2020, 6 mm. (21) Case before pupation: Bélmegyer, 8.06.2021, 8 mm (photos by A. Takács).



Figs 22-25. Biotopes, habitat and host plant of. *C. santonici* sp. nov. (22) Collection localities of *Coleophora santonici* sp. nov. (map by Kristóf Antal). (23-24) *Artemisia santonicum* (photos by Szabolcs Kis). (25) Habitat in Bélmegyer (photo by Gusztáv Boldog).

habitat west of Csanádalberti (at Száraz-ér) is also a short grass wormwood steppe with small patches of annual halophytic communities on alkali flats, and patches of mixed-grass meadow steppe on fertile soil. Habitat characteristics at Kosár-hát near Tiszafüred are similar. The vegetation is a mosaic of different communities developed in response to variable salt and moisture content of the soil (Borhidi, 2003). The dominant plant species in all three places is *Artemisia santonicum* (Borhidi, 2003).

The Habitat at Bélmegyer and Szabadkígyós (Figs 22f, g): The habitat of *Coleophora santonici* sp. nov. at Szabadkígyós (Kígyósi puszta) and near Bélmegyer is a mosaic of alkaline short grass steppe and a type of meadow steppe rich in tall forbs. The latter is found typically in the glades of pedunculate oak *Quercus petraea* woods as part of the forest steppe on alkali soil. The habitat is characterized by highly variable salt and moisture content of the soil. The vegetation is composed of plants of saline meadows, shortgrass alkaline steppe, and meadow steppe on chernozem soil, and rich in tall and erect fennel-like forbs. The habitat is prone to scrub invasion. Similar tall-forb communities with increasingly different species composition are broadly distributed in the eastern forest-steppe and steppe zone from Eastern Ukraine to the Altai Mountains (Borhidi *et al.,* 2012). The dominant plant species at both locations is *Artemisia santonicum* (Borhidi, 2003).

Etymology: The name derives from that of the host plant, *Artemisia santonicum*.

ACKNOWLEDGEMENTS

We are grateful to those who helped us in searching for cases: Diána Győri, István Harta, Kristóf Antal (Fejér County Government Office, Velence), Gábor Farkas (Békés County Government Office, Békéscsaba) and Gusztáv Boldog (Körös-Maros National Park). Special thanks to Gábor Lendvai (Aba, Hungary), Szabolcs Kis (University of Debrecen), Balázs Tóth and Zoltán Vas (Hungarian Natural History Museum, Hungary, Budapest) and Ignác Richter (Malá Čausa Slovakia) for their advice and professional help. Many thanks to Jukka Tabell (Hartola, Finland) for his opinion on the new species and information on other as yet undescribed species of the same group. We are indebted to Colin W. Plant (Bishops Stortford, UK) for linguistic corrections. Finally, we thank Bernard Landry (Geneva, Switzerland) for his revision of the text, corrections and useful advice, and to the reviewers for their comments and suggestions.

REFERENCES

Amsel H.G. 1935. Neue palästinensische Lepidopteren. *Mitteilungen aus dem Zoologischen Museum in Berlin* 20 (2): 271-319, pls 9-18.

Artimo P., Jonnalagedda M., Arnold K., Baratin D., Csardi G., de Castro E., Duvaud S., Flegel V., Fortier A., Gasteiger E., Grosdidier A., Hernandez C., Ioannidis V., Kuznetsov D., Liechti R., Moretti S., Mostaguir K., Redaschi N., Rossier G., Xenarios I., Stockinger H. 2012. ExPASy: SIB bioinformatics resource portal. *Nucleic acids research* 40(Web Server issue), W597-W603. https://doi.org/10.1093/nar/gks400

Baldizzone G. 1980. Contributions à la connaissance des Coleophoridae, XVIII. Description de deux espèces nouvelles du genre *Coleophora* Hübner: *C. pyrenaica* n. sp. et *C. lessinica* n. sp. pl. LI–LIV. *Alexanor* 11(5): 232-234.

Baldizzone G. 1983. Contributions à la connaissance des Coleophoridae, XXXI. Deux nouvelles espèces de Hongrie: *Coleophora magyarica* n. sp. et *C. remizella* n. sp. Les ♀♀ de *C. frankii* Schmid et de *C. hungariae* Gozmány. *Nota lepidopterologica* 6 (2-3): 69-80.

Baldizzone G. 1994. Contribuzioni alla conoscenza dei Coleophoridae. LXXV. Coleophoridae dell'Area Irano-Anatolica e regioni limitrofe (Lepidoptera). Associazione Naturalistica Piemontese, Memorie III, *Apollo Books* 1-424 pp.

Baldizzone G. 2019. Lepidoptera Coleophoridae. Fauna d'Italia. LIII. *Calderini, Bologna,* XVII + 907 pp.

Baldizzone G. & Tokár Z. 2008. *Coleophora impalella Toll, 1961,* a new record for Hungary (Lepidoptera: Coleophoridae). *SHILAP Revista de Lepidopterologia* 36 (144): 501-505.

Björklund M., Palmqvist G. 2002. *Coleophora jaernaensis* n. sp. (Lepidoptera: Coleophoridae), described from Sweden and Finland, and lectotype designation of *Coleophora sternipennella* (Zetterstedt, 1839). *Entomologisk Tidskrift* 123(3): 99-107.

Borhidi A. 2003. Plant associations of Hungary. *Akadémia kiadó, Budapest,* 610 pp. [in Hungarian]

Borhidi A., Kevey B., Lendvai G. 2012. Plant Communities of Hungary. Akadémia kiadó, Budapest. 544 pp.

Buschmann F., Pastorális G. 2018. Fifty years of changes in the Hungarian Microlepidoptera fauna (Lepidoptera) *Microlepidoptera.hu* 14: 77-258. 10.24386/Microlep.2018.14.5 [in Hungarian].

Buschmann F., Pastorális G., Richter I. 2014. The data for the new record of *Coleophora nigridorsella* Amsel, 1935 to the fauna of Hungary and to several other rare Coleophora species occurring in the country (Lepidoptera: Coleophoridae*). Microlepidoptera.hu* 7: 27-48. [in Hungarian].

Constant A. 1890. Descriptions de Microlépidoptères nouveaux ou peu connus. *Annales de la Société entomologique de France*. 6e série 10: 5-16, pl. 1.

Falkovitsh M.I. 1973. Contribution to the knowledge of casebearers (Lepidoptera, *Coleophoridae)* of the Kysylkum Desert. *Trudy Vsesoyuznogo Entomologicheskogo Obshchestva* 56: 199-233. [In Russian].

Folmer O., Black M., Hoeh W., Lutz R., Vrijenhoek R. 1994. DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology* 3: 294-299.

Gozmány L. 1954. Studies on Microlepidoptera. *Annales historico-naturales Musei nationalis hungarici* 46 (series nova 5): 273-285.

Gozmány L. 1955. Notes on Microlepidoptera. *Acta zoologica Academiae Scientiarum Hungaricae* 1 (3-4): 231-233.

Herrich-Schäffer G.A.W. 1847-1855 [1853–1855]. Systema-

tische Bearbeitung der Schmetterlinge von Europa, Zugleich als Text, Revision und Supplement zu Jakob Hübner's Sammlung Europäischer Schmetterlinge Band 5: die Schaben und Federmotten (pp. [1]-2-394 + [Index] 1–52), (pls. 1-124 [Tineides] + 1-7 [Pterophides] + 1 [Micropteryges]). G. J. Manz, Regensburg.

Hübner J. 1822. Systematisch-alphabetisches Verzeichnis aller bisher bey den Fürbildungen zur Sammlung europäischer Schmetterlinge angegebenen Gattungsbenennungen. Published by the author, Augsburg. vi+ 81 pp.

Kumar S., Stecher G., Tamura K. 2016. MEGA7: Molecular Evolutionary Genetics Analysis Version 7.0 for Bigger Datasets. *Molecular biology and evolution* 33(7): 1870-1874. https://doi.org/10.1093/molbev/msw054

Larkin M.A., Blackshields G., Brown N.P., Chenna R., Mcgettigan P.A., Mcwilliam H., Valentin F., Wallace I.M., Wilm A., Lopez R., Thompson J.D., Gibson T.J. & Higgins D.G. 2007. Clustal W and Clustal X version 2.0. *Bioinformatics* 23: 2947-2948.

Lendvai G. 2021. Results of the phytogeographical research of the Sárvíz mente (Mezőföld) I. Floristic data. *Kitaibelia,* 26(2): 207-226. https://doi.org/10.17542/kit.26.207 [in Hungarian]

Saitou N., Nei M. 1987. The neighbor-joining method: A new method for reconstructing phylogetetic trees. *Molecular Biology and Evolution* 4: 406-425.

Staudinger O. 1859. Diagnosen nebst kurzen Beschreibungen neuer andalusischer Lepidopteren. *Entomologische Zeitung* (Stettin) 20: 211-259.

Szabóky Cs., Takács A. 2021. New data to the Microlepidoptera fauna of Hungary, part XIX (Lepidoptera: Batrachedridae, Coleophoridae, Gracillariidae, Tortricidae). *Folia Entomologica Hungarica* 82: 43-53. https://doi: 10.17112/FoliaEntHung.2021.82.43

Tamura K. 1992. Estimation of the number of nucleotide substitutions when there are strong transition-transversion and G+C content biases. *Molecular Biology and Evolution* 9: 678-687.

Toll S. 1961. Materialien zur Kenntnis der paläarktischen Arten der Familie Coleophoridae (Lepidoptera). *Acta zoologica Cracoviensia*, Państwowe Wydawnictwo Naukowe - Oddział Kraków: 80-89.

Toll S., Amsel H.G. 1967. Coleophoriden aus Afghanistan (Lepidoptera: Coleophoridae). *Beiträge zur Naturkundlichen Forschung in Südwestdeutschland* 26 (3, Afghanistan-Heft): 5-16.

Walsingham Lord T. de G. 1910. New Corsican and French Microlepidoptera. *The Entomologist's Monthly Magazine* 46: 231-233.

Zeller P.C. 1868. Beitrag zur Kenntniss der Lepidopteren-Fauna der Umgegend von Raibl in Oberkärnthen und Preth im angrenzenden Küstengebiet. *Verhandlungen der kaiserlich-königlichen zoologisch-botanischen Gesellschaft in Wien* 18: (Abh.) 563-628.

Revue suisse de Zoologie (September 2022) 129(2): 323-327 ISSN 0035-418

Micropeplus shergyla sp. nov., the first species of Micropeplinae from Tibet (Coleoptera: Staphylinidae)

Zi-Wei Yin

Laboratory of Environmental Entomology, College of Life Sciences, Shanghai Normal University, 100 Guilin Road, Xuhui District, Shanghai 200234, China; pselaphinae@gmail.com; https://orcid.org/0000-0001-6659-9448

Abstract: *Micropeplus shergyla*, a new species of the Staphylinoides group and the first species of Micropeplinae from Tibet, is described, illustrated, and compared with geographically close and morphologically similar congeners.

Keywords: Taxonomy - rove beetles - micropeplines - Xizang - China.

INTRODUCTION

The Chinese fauna of the staphylinid subfamily Micropeplinae is represented by 26 species and one subspecies in three genera, *i.e.*, *Cerapeplus* Löbl & Burckhardt and *Peplomicrus* Bernhauer each with a single species, and *Micropeplus* Latreille containing 24 species and one subspecies (*e.g.*, Löbl 1997; Li *et al.*, 2019). Grebennikov & Smetana (2015) identified a potentially diverse micropepline fauna from southwestern China based on applications of BINs (Barcode Index Numbers), GDTCs (Geographically Delimited Terminal Clades), and OTUs (Operational Taxonomic Units), and questioned the monophyly of *Micropeplus*. Morphologically, more than half of the known Chinese *Micropeplus* species (14 spp. and 1 subsp.) belong to the diverse Holarctic Staphylinoides group (for a diagnosis and a description of the group see Campbell, 1992): *M. longipennis* Kraatz from Heilongjiang, *M. fulvus fulvus* Erichson from Liaoning, *M. shanghaiensis* L.-Z. Li & Zhao from Shanghai, *M. fulvus japonicus* Sharp, *M. sinensis* Watanabe, and *M. unicornis* X.-K. Yang from Zhejiang, *M. clypeatus* Campbell, *M. spinatus* Campbell, *M. taiwanensis* Campbell, and *M. yushanensis* Campbell from Taiwan, and *M. liweiae* Wang, Jiang & Zhu, *M. nomurai* Watanabe, *M. songi* Zheng, Y.-J. Li & Yan, *M. uenoi* Watanabe, and *M. xiaoae* Zheng, Yan & Y.-J. Li from Sichuan (Watanabe & Luo, 1991; Campbell, 1992, 1995; J.-K. Li & Chen, 1993*; Yang, 1995; Watanabe, 2000; L.-Z. Li & Zhao, 2001; Tronquet, 2008; Wang *et al.*, 2018; Zheng *et al.*, 2013, 2014). [*The identification of all staphylinids in the book by J.-K. Li & Chen should be considered doubtful due to inadequate descriptions and their insufficient knowledge of the group.] With few exceptions, most of these species are regionally or locally endemic, and usually prefer more northern temperate regions (*e.g.*, in Liaoning and Heilongjiang), or inhabit high-altitude montane environments in subtropical areas (*e.g.*, in Taiwan and Sichuan).

During a 2021 expedition to Tibet accompanied by my colleague Zhong Peng and MA student Wen-Xuan Zhang, two specimens of an interesting new species of *Micropeplus* were collected at high altitude at Shergy La (mountain pass) in Nyingchi, which represents the first record of the subfamily Micropeplinae in Tibet. In this paper, the new species is described and separated from geographically close and morphologically similar congeners.

MATERIAL AND METHODS

The type material of the new species described in this paper is deposited in the Insect Collection of Shanghai Normal University, Shanghai, China (SNUC). The text of the specimen label is quoted verbatim in quotation marks (‘’).

Dissected parts were preserved in Euparal on plastic slides that were placed on the same pin with the specimen. The habitus image of the beetle was taken using a Canon 5D Mark III camera in conjunction with a Canon MP-E 65 mm f/2.8 1-5X Macro Lens, and a Canon MT-24EX Macro Twin Lite Flash was used as the light source. Images of the morphological details were produced using a Canon G9 camera mounted to an Olympus CX31 microscope under reflected or transmitted light. Zerene

Manuscript accepted 20.06.2022
DOI: 10.35929/RSZ.0079

Stacker (version 1.04) was used for image stacking. All images were modified and arranged into plates using Adobe Photoshop CC 2018.

The abdominal segments are numbered in Arabic (starting from the first visible segment) and Roman (reflecting true morphological position) numerals, *e.g.*, tergite 1 (III), or sternite 1 (III). Paired structures in species description are treated as singular, which are in telegraphic text, and treated as plural in the comparative notes.

TAXONOMY

Micropeplus shergyla sp. nov.

Figs 1, 2

Chinese common name: 色季拉铠甲

Type material: HOLOTYPE; ♂; CHINA, 'China: Xizang, Nyingchi City, Shergy La, Lulang tourist center, 29°37'2"N, 94°41'55"E, 4300 m, 14.vii.2021, Peng, Yin & Zhang, 色季拉游客中心北坡' (SNUC). PARATYTYPE; 1 ♂; CHINA, same collection data as of holotype (SNUC).

Description: Habitus (Fig. 1A) elongate-oval, slightly convex in profile view. Body length (from anterior margin of frons to posterior margin of abdomen) 2.3-2.6 mm, width (maximum width of pronotum) 1.1-1.2 mm. Head black; antennae with antennomeres 1-8 reddish-brown, 9 dark brown for basal 2/3 and reddish-brown for apical 1/3; pronotum blackish, with lateral lobes reddish-brown; elytra black, with posterior margin reddish-brown; scutellum black at base, reddish brown medially at apex; abdominal tergites 1-4 (III–VI) black, 5 (VII) black along base, becoming lighter toward posterior margin, 6 (VIII) reddish-brown; paratergites black with reddish-brown lateral margins; femora and tibiae reddish-brown; genital segments, mouthparts and tarsi yellowish.

Head (Fig. 1B) strongly transverse, length from anterior margin of clypeus to anterior margin of pronotum 0.36-0.39 mm, maximum width across eyes 0.58-0.59 mm; dorsal surface with dense reticulate microsculpture, lacking punctation, almost devoid of pubescence; vertex with basally divergent mediobasal ridge extending anteriorly to vertex, with one distinct glandular pore on each side of base of ridge, areas lateral to ridge shallowly impressed and with raised outer edges, with transverse ridge mesal to raised inner margin of each eye demarcating anterior and posterior impressed areas; frons broadly and conspicuously impressed between weakly raised dorsal surface of antennal insertions, anterior margin not sexually dimorphic; clypeus demarcated from frons by frontal-clypeal ridge, anterior margin of clypeus broadly arcuate and moderately raised. Venter with fine reticulate or transverse linear microsculpture, with multi ridges separating impressed areas; submentum with one oval, admesal impression on each side near base. Eyes prominent. Antennae short, length 0.63 mm, sparsely pubescent except for antennomere 11; antennomere 1 large, convex on mesal margin; 2 broadened at basal half and narrowing apically; 3 as long as 2, basally narrowed; 3-8 successively shorter; 9 slightly transverse; 11 largest, suboval, truncate at base, with dense pubescence; length/width of antennomeres 1-11 including basal stalks (holotype; in mm): 1 0.11/0.06, 2 0.07/0.05, 3 0.07/0.04, 4 0.06/0.04, 5 0.05/0.03, 6 0.04/0.03, 7 0.04/0.03, 8 0.03/0.04, 9 0.14/0.10.

Pronotum (Fig. 1B) distinctly transverse, length at midline 0.52-0.54 mm, maximum width 1.11-1.14 mm, greatest width at subbasal marginal teeth; sides evenly convex, lateral margins with 3-4 teeth, basal teeth larger than apical ones; anterior margin weakly convex between lateral lobes which extend anteriorly to level of eyes; posterior broadly convex at middle, laterally evenly emarginate to round posterolateral angles; disc moderately convex, much lower than profile of elytra, median area with closed cells arranges as in Fig. 1B, with two large glandular pores at outer sides of each lateral carina; reticulate microsculpture present on disc, inner margins of cells and outer 2/3 of explanate lateral areas; posterolateral area flattened, translucent. Hypomera with reticulate microsculpture lateral and posterior to large, deep, oval cavities. Proventral carina narrow, present only on anterior half; proventral process broad.

Scutellum (Fig. 1C) slightly convex, shield-shaped, 1.42-1.46 times as broad as long, with fine microsculpture at middle. Elytra (Fig. 1C) subquadrate, parallel sided, length along suture 0.68-0.71 mm, maximum width 1.10-1.13 mm, widest at approximately posterior 1/5, at widest point about as wide as pronotum, in profile view broadly convex and above plane of pronotum; each elytron with two large glandular pores at base, with inner discal costa slightly sinuate, outer discal costa slightly curved at base, pseudepipleural costa almost straight, separated anteriorly and posteriorly from epipleural costa; discal area of pseudepipleuron slightly flared externally so that pseudepipleural costa visible from dorsal view; epipleuron narrow, with row of coarse punctures; elytral intervals with punctures moderately coarse and deeply impressed, separated by average distance distinctly greater than diameter of puncture, surface between intervals smooth, lacking microsculpture; punctures evenly distributed over intervals, first interval approximately three punctures wide, second approximately 5 punctures wide and third interval six to seven punctures wide. Metathoracic (hind) wings fully developed.

Mesoventrite (Fig. 2A) with reticulate microsculpture at middle and at inner margins of impressed cells; mesoventral process broad, convex on posterior margin. Metaventrite (Fig. 2A) narrowly and shallowly impressed along midline from anterior 1/4 to near posterior margin, followed by slightly transverse, suboval, moderately impression just anterior to posterior margin; with shorter, broader and shallow parallel impression on each side of

Fig. 1. *Micropeplus shergyla* sp. nov., male: (A) Dorsal habitus. (B) Head and pronotum. (C) Elytra. Scale bars: 0.5 mm in A; 0.3 mm in B, C.

medial impression slightly posterior to middle of disc; with broadly triangular impression on anterior margin at middle; with obliquely oval impression posterior to mesocoxa, with large glandular pore posterior to mesocoxal cavity but lacking pores at anterior margin of metaventral intercoxal process; with two longitudinal impressions on each side of lateral area; microsculpture of metaventrite mostly confined to impressions, lacking pubescence or punctures.

Abdomen slightly wider than long, length at midline 0.88-1.03 mm, maximum width (at lateral margins of segment 1) 1.03-1.12 mm; tergites (Fig. 2B) and sternites (Fig. 2C) successively narrowing posteriorly; microsculpture present on ridges, accompanying paratergites and lateral areas of sternites; all segments asetose. Tergite 1 (III) with one short, thin median carina, 2-4 (IV-VI) each with broad median and pair of slightly narrower lateral carinae extending from anterior margin to posterior margin (middle carinae) or near posterior 3/5 of tergite (lateral carinae); tergite 5 (VII) with three short carinae extending to basal 1/3 of tergite; median carina of tergite 5 slightly declivous in lateral view. Sternite 1 (III) with ten, 2-5 (IV-VII) each seven short carinae along basal margin, 5 with carinae present only at base, with broad, triangular impression on intercoxal process.

Male. Protibia lacking tooth on mesal margin; mesal margins of meso- and metatibia (Fig. 1A) each with acute triangular tooth posterior to middle. Posterior margin tergite 6 (VIII) evenly and slightly curved. Posterior margin of sternite 6 (VIII) roundly emarginate at middle, with transverse row of short subbasal setae. Aedeagus (Fig. 2D, E) short and broad, length 0.52 mm,

Fig. 2. *Micropeplus shergyla* sp. nov., male: (A) Meso- and metaventrite. (B) Tergites. (C) Sternites. (D, E) Aedeagus, ventral (D) and lateral (E). Scale bars: 0.3 mm in A-C; 0.2 mm in D, E.

with subparallel sides; median lobe with apex broad and strongly emarginate; parameres fused to median lobe, in lateral view narrowing apically and acute at apex, each side with two long subapical setae; endophallus symmetric, composed of three pairs of elongate sclerites. *Female*. Unknown.

Comparative diagnosis: This species is morphologically similar to *M. liweiae*, *M. songi*, and *M. xiaoae* from Sichuan regarding the dark coloration of the body, and a sexually unmodified (evenly convex) anterior margin of the male frons. *Micropeplus shergyla* differs from *M. liweiae* by more evenly convex lateral margins of the pronotum (nearly straight for most of the length in *M. liweiae*), less convex lateral margins of the elytra, and much thinner posterior halves of the median carinae of tergites 2-4 (IV-VI) and thinner median carina of tergite 5 (VII); and from both *M. songi* and *M. xiaoae* by the incomplete lateral carinae of tergites 2-4 (IV-VI) (all three carinae extending through whole length of tergites 2-4 in *M. songi* and *M. xiaoae*). The apical structure of the aedeagal median lobe and the shape of the endophallus of *M. shergyla* are also characteristic. Two other species from Sichuan, *M. uenoi* and *M. nomurai*, both having the male frons protruding anteriorly at middle, can be readily separated from

M. shergyla. There are three more *Micropeplus* species from the Himalayan range (Schülke & Smetana, 2015; Newton, 2018): *M. editus* Herman (replacement name for *M. maillei* Laporte) from Nepal, *M. vulcanus* Fauvel from northern India, and *M. sikkimi* Fauvel from northern India and Pakistan. Neither of these belongs to the Staphylinoides group, their body sizes fall out of the range of the group and are much shorter (*ca*. 1.5 mm long) than in *M. shergyla*.

Distribution and habitat: China: Tibet. Both individuals were collected by sifting leaf litter in a *Rhododendron* dominant forest at an altitude of 4300 m.

Etymology: This species is named after its type locality, i.e., Shergy La ('La' means 'a mountain pass' in Tibetan).

ACKNOWLEDGMENTS

I am grateful to Zhong Peng and Wen-Xuan Zhang for their companionship during the 2021 Tibetan expedition. Wa Da (Tibet Plateau Institute of Biology, Lhasa) provided logistical support to the field work. Volker Assing (Hannover, Germany) and an anonymous reviewer critically read the draft manuscript and provided helpful comments. The present study was supported by the National Natural Science Foundation of China (grant no. 31872965), the Second Tibetan Plateau Scientific Expedition and Research (grant nos. 2019QZKK0706, 2019QZKK05010603), and the Science and Technology Commission of Shanghai Municipality (grant no.19QA1406600).

REFERENCES

Campbell J. M. 1992. A review of the family Micropeplidae (Coleoptera) of Taiwan. *Bulletin of the National Museum of Natural Science* 3: 209-224.

Campbell J. M. 1995. New species and records of Micropeplidae (Coleoptera) from Taiwan. *Bulletin of the National Museum of Natural Science* 5: 117-130.

Grebennikov V. V., Smetana A. 2015. DNA barcoding and regional diversity of understudied Micropeplinae Coleoptera: Staphylinidae) in Southwest China: phylogenetic implications and a new *Micropeplus* from Mount Emei. *Zootaxa* 3919: 583-599.

Li J.-K., Chen P. 1993. Studies on fauna and ecogeography of soil animal (*sic*!). *Northeast Normal University Press, Changchun*, ii + 265 pp. (in Chinese, with English title).

Li L.-Z., Zhao M.-J. 2001. *Micropeplus shanghaiensis*, a new species (Coleoptera, Staphylinidae) from East China. *Japanese Journal of Systematic Entomology* 7: 91-94.

Li L.-Z. (chief Ed.), Hu J.-Y., Peng Z., Tang L., Yin Z.-W., Zhao M.-J. (eds). 2019. Catalogue of Chinese Coleoptera. Volume 3: Staphylinidae. *Science Press, Beijing*, xix + 720 pp.

Löbl I. 1997. *Cerapeplus sinensis* n. sp. (Coleoptera: Staphylinidae: Micropeplinae) from China. *Serangga* 2: 137-142.

Newton A. F. 2018. Staphyliniformia world catalog database. *In*: Bánki O., Roskov Y., Döring M., Ower G., Vandepitte L., Hobern D., Remsen D., Schalk P., DeWalt R. E., Keping M., Miller J., Orrell T., Aalbu R., Adlard R., Adriaenssens E., Aedo C., Aescht E., Akkari N., Alonso-Zarazaga M. A. *et al*. (eds), Catalogue of Life Checklist (November 2018). *www.catalogueoflife.org/data/dataset/1204* (accessed 5 March 2022)

Schülke M., Smetana A. 2015. Family Staphylinidae Latreille, 1802. *In*: Löbl I., Löbl D. (eds), Catalogue of Palaearctic Coleoptera. Vol. 2/1. Hydrophiloidea – Staphylinoidea. Revised and updated edition. *Brill, Leiden and Boston*, pp. 304-1134.

Tronquet M. 2008. Staphylinidae Micropeplinae de la faune de France et contrées voisines des genres *Arrhenopeplus* (Koch, 1937) et *Micropeplus* Latreille, 1809. *Revue de l'Association Roussillonnaise d'Entomologie* 16 (2007): 104-116.

Wang C.-B., Jiang R.-X., Zhu J. 2018. *Micropeplus liweiae* sp. n., a new species from Sichuan, China (Coleoptera, Staphylinidae, Micropeplinae). *ZooKeys* 775: 97-102.

Watanabe Y. 2000. Two new micropepline beetles (Coleoptera, Staphylinidae) from Sichuan Province, southwest China. *Elytra* 28: 45-53.

Watanabe Y., Luo Z.-Y. 1991. The micropeplids (Coleoptera) from the Tian-mu Mountains in Zhejiang Province, East China. *Elytra* 19: 93-100.

Yang C. 1995. Coleoptera: Micropeplidae. *In*: Wu H. (ed.), The series of the Bioresources Expedition to the Baishanzu Mountain nature reserve. *China Forestry Publishing House, Beijing*, pp. 218-219.

Zheng F.-K., Yan X.-H., Li Y.-J. 2013. A new species of the genus *Micropeplus* Latreille from Sichuan, China (Coleoptera, Staphylinidae, Micropeplinae). *Acta Zootaxonomica Sinica* 38: 303-306.

Zheng F.-K., Li Y.-J.,& Yan X.-H. 2014. A new species of the genus *Micropeplus* Latreille (Coleoptera: Staphylinidae: Micropeplinae) from China. *Zoological Systematics* 39: 445-448.

Revue suisse de Zoologie (September 2022) 129(2): 329-341 ISSN 0035-418

A revision of the *Apamea fasciata* (Leech, 1900) species complex (Noctuidae, Xyleninae, Apameini)

Gábor Ronkay[1*], László Ronkay[1*], Bernard Landry[2] & Alberto Zilli[3]

[1] *Heterocera Ltd, H-1137 Budapest, Szt. István krt 4, Hungary*
[2] *Muséum d'histoire naturelle de Genève, C.P. 6434, CH-1211 Geneva 6 Switzerland*
[3] *Natural History Museum, Department of Life Sciences, Cromwell Road, SW7 5BD London, UK*
* *Corresponding authors: gaborronkay@gmail.com, laszlo.ronkay@gmail.com*

Abstract: The *Apamea fasciata* (Leech, 1900) species complex is revised, five new species, *A. norbertkeili* (Nepal), *A. stangelmaieri* (Nepal), *A. bernhardmayi* (India, Khasis), *A. ploessli* (Taiwan) and *A. ericmetzleri* (Nepal) are described.

Keywords: *Apamea fasciata* - species complex - new species - Himalayan-Sino-Taiwanese region.

INTRODUCTION

The curiosity of the *Apamea fasciata* (Leech, 1900) complex is most expressive in the mirror of the taxonomic constraints of the entire clade including the *fasciata* group. The species complex has long been treated as a single species (e.g. Chang, 1991; Chen, 1999; Draudt, 1950; Fu & Tzuoo, 2002, 2004; Hampson, 1908; Hreblay *et al.,* 1998; Owada, 1992; Warren, 1911; Zilli *et al.,* 2005) despite the clearly recognisable differences in the genitalia of both sexes of the otherwise externally often confusingly similar species. Moreover, the species of the *fasciata* group represent two parallel lineages the existence of whose have been first documented only during the monographic treatment of the *Apamea* generic complex (Zilli *et al.,* 2009), together with the separation of *A. herczigi* Zilli, Varga, Ronkay & Ronkay, 2009 from *A. fasciata* (Leech, 1900). It is worth to note that the externally also somewhat similar Taiwanese endemic species, *A. ikerfasciata* Zilli, Varga, Ronkay & Ronkay, 2009 represents another, as yet monobasic, species group being rather remote taxonomically from the *fasciata* group.

The subsequent study was initiated by the investigations on certain historical southern Himalayan *Apamea* material in the NHM London from the Khasia Hills and NW India, and the new materials from Taiwan but the results remained still unpublished.

The final impulse for the clarification of the remarkably higher taxonomic diversity of the species complex was the establishment of the Jacques Plante Noctuidae Collection Project which targeted the identification of all specimens preserved in this large collection harboured in the MHN Geneva. The detailed study of the specimens of the *Apamea fasciata* group proved the distinctness of the southern Himalayan populations formerly identified as *fasciata* from the typical population occurring in Sichuan and pinpointed the sympatric occurrence of three closely related taxa of the group in Nepal. In summary, the *Apamea fasciata* complex includes altogether seven closely related species belonging to two parallel lineages, five of which are new for the science and are described below. The 8th species of this clade, *A. ikerfasciata*, is considered as the supposed outgroup of the *Apamea fasciata* species group within the genus *Apamea* Ochsenheimer, 1816.

It is important to note that the genitalia of the true *A. fasciata* (type locality: China, Sichuan) have never been illustrated and are published here correctly for the first time. The genitalia plate 115 in the 3rd volume of the Witt Catalogue (Zilli *et al.,* 2009) illustrates in reality its sister species, *A. norbertkeili* sp. n.

MATERIAL AND METHODS

The method of surveys was traditional taxonomic, based on materials of state museums and private collections, electronic databases and large set of digitalised microscopic slides. We revised the comprehensive type material and other important voucher specimens from several internationally important European collections (see: Abbreviations).

The genital dissections were made by the technique

Manuscript accepted 22.06.2022
DOI: 10.35929/RSZ.0080

published by Robinson (1976), with certain modifications (Fibiger & Goater, 1997). Potassium hydroxide (15% solution KOH) was used to macerate the full abdomen. The cleaned genital capsule, everted vesica and female copulatory organ were dehydrated in 96 % ethanol; the weakly sclerotized structures were stained with eosin red or chlorazol black then mounted to Euparal.

The habitus of the specimens was photographed with a Nikon D90 camera; the images of the genitalia slides were taken partly by a Nikon Eclipse 80i photomicroscope with Nikon DS-Fi2 digital camera. The images are preserved in the photo catalogue of the Heterocera Ltd, Budapest and the image database of the Museum d'histoire naturelle, Geneva.

Terminology of genitalia follows Zilli *et al*. (2009).

ABBREVIATIONS

AZ – slide of Alberto Zilli;
BJ – slide of János Babics;
GYP – genitalia slide of Péter Gyulai;
HNHM – Hungarian Natural History Museum, Budapest, Hungary;
LG – slide of Gyula M. László;
MH – slide of Márton Hreblay;
MHNG – Muséum d'histoire naturelle, Geneva, Switzerland;
MHNG-ENTO – Individual identity code number of the Entomological Collection of the Museum d'histoire naturelle, Geneva;
NHM UK – Natural History Museum (formerly British Museum, Natural History), London, United Kingdom;
NHMW – Naturhistorisches Museum, Vienna, Austria;
NMNS – National Museum of Natural Sciences, Taichung, Taiwan;
RL – genitalia slide of László Ronkay;
VZ – genitalia slide of Zoltán Varga;
ZFMK – Zoologisches Forschungsmuseum Alexander Koenig (formerly AKM), Bonn, Germany;
ZSM – Zoologische Staatssammlung, Munich, Germany.

TAXONOMIC PART

The proper taxonomic position of the *fasciata* species group within the genus *Apamea* (subgenus *Apamea*) is discussed by Zilli *et al.* (2009). The species complex includes externally often confusingly similar species belonging to two main lineages distinguished by the configuration of the genitalia of both sexes. The first group (the *fasciata*-lineage, containing the type species) is characterised by the distally curved aedeagus (phallus) having short, globular vesica armed by 1-2 subbasally positioned, broad-based cornuti and often with a third, small, finely bulbed ventral spine in the males and by the narrow, ring-like antrum fused with the broadly calyculate and short ductus bursae having strong, sclerotised internal crests and ribs in the female copulatory organ (Figs 1-6). The second group (the *herczigi*-lineage) possesses more elongated vesica with the ventral, bulbed cornutus sitting on a tubular, medium-long diverticulum in the males, more distinctly produced antrum and more elongated, rather tubular ductus bursae in the females, having more sclerotised, longitudinally cristate-ribbed posterior and variably large and inflated, also ribbed-rugose antero-lateral section, positioned oppositely with shortly subconical appendix bursae (Figs 7-12).

It is worth to note that the female genitalia features display much more conspicuous differences between the two lineages and the closely related species than the males; the only exception is the *fasciata-norbertkeili* species pair where the female genitalia of the two species are rather similar while the armature of the carina penis and the vesica show clearly recognisable differences (see the Figs 1-4).

The synopsis of the *Apamea fasciata* species group is as follows:

fasciata lineage
fasciata (Leech, 1900)
norbertkeili sp. n.
stangelmaieri sp. n.

herczigi lineage
bernhardmayi sp. n.
ploessli sp. n.
ericmetzleri sp. n.
herczigi Zilli, Varga, Ronkay & Ronkay, 2009

Apamea fasciata (Leech, 1900)

Figs 1-2, 13-14

Xylophasia fasciata Leech, 1900: 68.

Type material examined: Lectotype male, "Chia-Kou-Ho, 1700 ft. A.E. Pratt coll., July 1889", slide No. LG3048m (coll. NHM UK). – Paralectotypes: 1 male, 1 female, "Pu-tsu-Fang, 9820 ft., Native coll. June & July 1890"; slide No. LG3049f (coll. NHM UK).

Diagnosis: *Apamea fasciata* resembles externally mostly to its allopatric twin-species, *A. norbertkeili* and *A. herczigi* by its narrow, on both sides laced inner area of marginal field with less prominent whitish ashy grey suffusion. There are no diagnostic external features between *A. fasciata* and the darker, less whitish-grey marked specimens of *A. norbertkeili* but they are well-separable by the genitalia of both sexes. *Apamea fasciata* is better distinguished from the other three Himalayan species, *A. stangelmaieri, A. bernhardmayi* and *A. ericmetzleri*, from the first by its larger size (wingspan 37-39 mm vs 33-36 mm, respectively) and more elongated forewings with much weaker pale

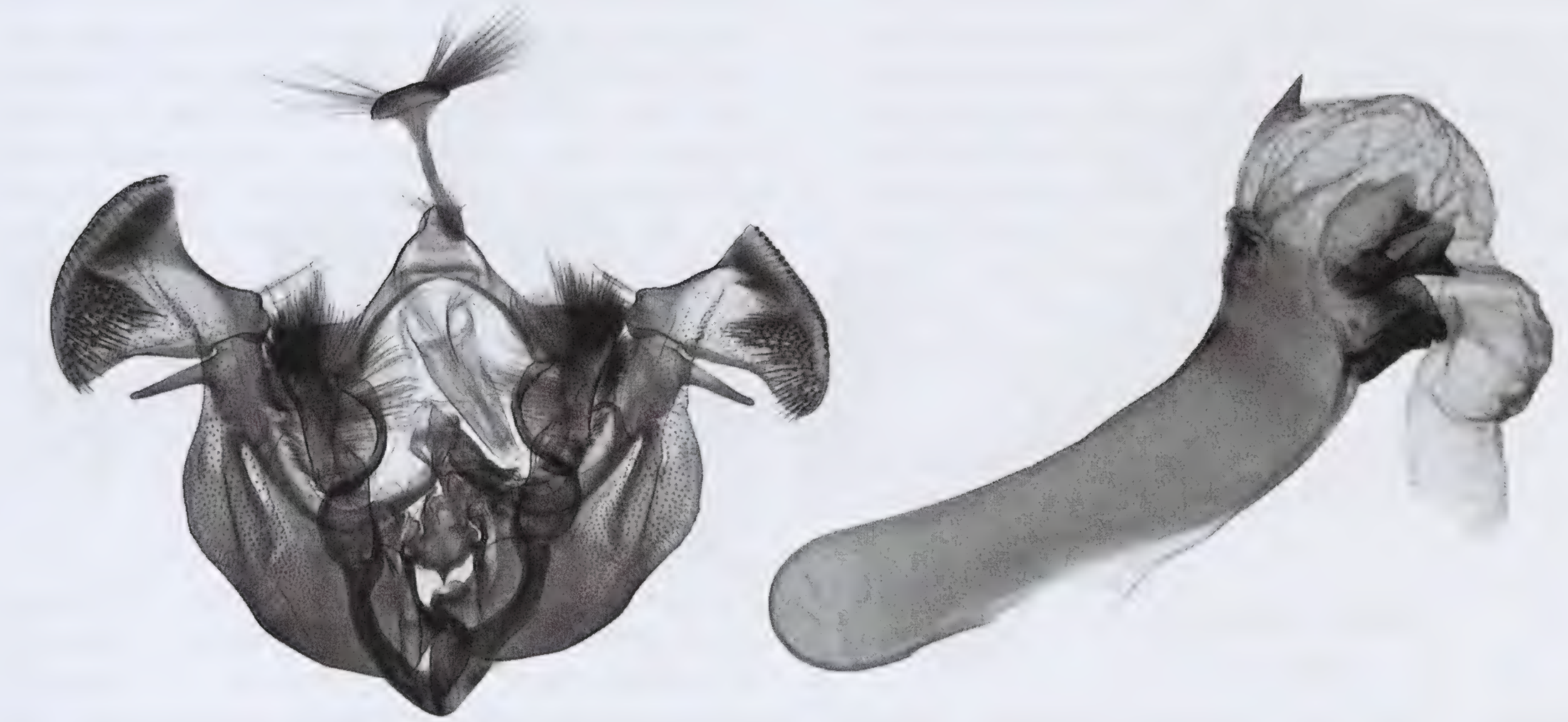


Fig. 1. *Apamea fasciata* (Leech, 1900), genitalia, LG3048m, Lectotype, China, Sichuan.

Fig. 2. *Apamea fasciata* (Leech, 1900), genitalia, LG3049f, Paralectotype, China, Sichuan.

greyish areas; from the latter two species by its broader and less elongated, apically less pointed forewings and more extensive pale grey suffusion of the basal area.

It is worth to note that the known specimens have a rather uniform external appearance; their forewing pattern is almost invariable.

The male genitalia of *A. fasciata* (Fig. 1.) differ conspicuously from those of the other two species of the *fasciata* lineage by the prominent, heavily sclerotised dorsal carinal tooth and the smooth, short ventral carinal extension of aedeagus. This feature is unique within the entire species complex, all other known members have smooth, unspecialised dorsal carinal plate and much stronger ventral carinal process with variously developed spine(s). The vesica is armed by a large, broad-based and two smaller, conical cornuti, that of *A. norbertkeili* (Fig. 3) has two large, broad-based cornuti and a smaller but strong conical spine, while that of *A. stangelmaieri* (Fig. 5) is armed by one or two large broad-based thorns. The clasping apparatuses of *A. fasciata* and *A. norbertkeili* are also different in certain features as the cucullus of *A. fasciata* is more symmetrically developed and axe-shaped with more convex outer margin, the digitus is longer and more pointed and the juxta has narrower, more evenly rounded basal (ventral) section with more prominent ventro-medial spine.

The female genitalia of *A. fasciata* (Fig. 2) are very similar to those of *A. norbertkeili* (Fig. 4), they differ in the shape and size of the ovipositor and the sclerotised inner plates of the antrum-ductus bursae complex. In the ovipositor,

the papillae anales of *A. fasciata* are shorter and less robust than in *A. norbertkeili,* the apophyses anteriores are shorter and thinner and the internal sclerotized plates of ductus bursae are larger, more flattened, extending to the anterior end of the large semiglobular organ. The anal papillae of *A. fasciata* are proportionally shorter but broader than those of *A. stangelmaieri* (Fig. 6), the antrum-ductus bursae complex is remarkably larger, proximally more rounded and the internal sclerotised plates are less symmetrical and less quadrangular than in *A. stangelmaieri.*

Distribution: Sino-Tibetan. The species seems to be restricted to the SE Tibetan high mountains in Sichuan.

Apamea norbertkeili sp. n.

Figs 3-4, 15-16

Holotype: Male, Nepal, Annapurna Himal, Noma pasture, 11 km SE Jomsom, 4000 m, 28°44,5'N, 83°48'E, 17-18.JUL.1995, leg. G. Csorba, Gy.M. László & G. Ronkay; slide No. RL12935m (coll. G. Ronkay, NHMW).

Paratypes

Nepal. West Nepal. 1 ♀, 21 km N of Dailekh, 3400 m, 1-2.AUG.1996, leg. M. Hreblay & B. Szin, MHNG-ENTO-0067520 (coll. MHNG). – 1 ♀, 20 km N of Dailekh, 3000 m, 03.AUG.1996, leg. M. Hreblay & B. Szin, MHNG-ENTO-0067519 (coll. MHNG).

Annapurna Himal. 1 ♂, 1 ♀, with same data as holotype, slide No. RL12938f (coll. G. Ronkay, NHMW). – 1 ♀, Thadung, 5 km SE Jomsom, 3450 m, 28°46'N, 83°46'E, 09.JUL.1995, leg. G. Csorba, Gy. M. László & G. Ronkay, slide No. RL12937f (coll. G. Ronkay, NHMW). – 1 ♀, Banthanti, 2500 m, 28°22,5'N, 83°43'E, 25.JUL.1995, leg. Gy. M. László & G. Ronkay, slide No. AZ1319f (coll. G. Ronkay, NHMW). – 1 ♀, Deorali, 3100 m, 83°43'E, 28°24'N, 5-6.OCT.1994, leg. G. Csorba & L. Ronkay (coll. HNHM).

Ganesh Himal. 1 ♂, 3 km SE from Somdang, 3450 m, 25.JUL.1995, 28°11'N, 83°13'E, leg. M. Hreblay & T. Csővári, MHNG-ENTO-0067545, slide No. HM8220m (coll. MHNG).

Solu Khumbu Himal. 1 ♂, Tragsindha Pass, 3000 m, 04.JUL.1993, leg. M. Hreblay & G. Csorba, slide No. RL12936m (coll. G. Ronkay, NHMW). – 2 ♀, from same locality and data, MHNG-ENTO-0067509, 0067511 (coll. MHNG). – 1 ♀, 12 km E of Lukla, Yak Kharka, 4000 m, 30.JUN.1993, leg. M. Hreblay & G. Csorba, MHNG-ENTO-0067512 (coll. MHNG). – 3 ♂, 1 ♀, Lukla, 2800 m, 02.JUL.1993, leg. M. Hreblay & G. Csorba, MHNG-ENTO-0067507, 0067508, 0067510, and 0067546 (slide RL13057m) (coll. MHNG).

Diagnosis: *Apamea norbertkeili* is the most widespread and externally most variable species of the *A. fasciata* species complex; the other known members of the species group display no remarkable variation in the forewing colouration and pattern. It differs externally from *A. fasciata* by its on average larger size (wingspan 37-42 mm vs 37-39 mm, respectively) and more elongated wings, otherwise there are specimens of the new species which can be distinguished from *A. fasciata* only by the study of the genitalia. The forewing ground colour of the new species varies from rather pale reddish-brown to deep brown, rarely entirely pale brownish coloured specimens also can be found. The intensity of the pale whitish-grey basal and marginal suffusion is also variable from the week or even subtle greyish shade to the prominently bluish ash-grey covering.

Apamea norbertkeili is separable from the partly sympatrically occurring *A. stangelmaieri* by its large size (wingspan 37-42 mm vs 33-36 mm), more elongated and slightly more pointed forewings with generally weaker pale basal and submarginal suffusion, and by the darker, more intensely brown suffused hindwings having sharper defined transverse line and discal spot on both surfaces. It differs from the also partly sympatric relative, *A. ericmetzleri* (and also the allopatric *A. bernhardmayi*) by its broader, less pointed forewings and the different shape of the light marking of the basal area; in addition, the latter species is larger in size, the largest known member of the group by its wingspan 42-45 mm.

The male genitalia of the new species (Fig. 3) differ conspicuously from those of *A. fasciata* (Fig. 1) by the position of the carinal thorn as it is ventral in *A. norbertkeili* but dorsal in *A. fasciata*. The clasping apparatuses of the two species are also different, the cucullus of *A. norbertkeili* is more elongated and more asymmetrical, the ventral part is longer and slenderer and the outer margin is almost straight, not strongly convex as in *A. fasciata*. In addition, the juxta of *A. norbertkeili* is basally broader and more quadrangular than that of *A. fasciata*. The vesica of *A. norbertkeili* is armed by two large, broad-based cornuti and a small but strong, conical cornutus; from the armature of the vesica of *A. stangelmaieri* (Fig. 5) the conical spine is absent.

The female genitalia of *A. norbertkeili* (Fig. 4) differ from those of the very similar *A. fasciata* (Fig. 2) by the stronger, more elongated and basally (proximally) less dilated papillae anales, the longer apophyses anteriores and the shorter, more rugose-folded internal sclerotized plates of ductus bursae. The anal papillae of *A. norbertkeili* are proportionally longer and stronger than those of *A. stangelmaieri* (Fig. 6), the antrum-ductus bursae complex is larger and proximally more rounded, and the internal sclerotised plates are less symmetrical and not reaching the anterior extremity of the organ as in *A. stangelmaieri.*

Distribution: Southern Himalayan. The known range of the species is extending from the western third of Nepal to the Kanchenjunga Himal bordering the Sikkim region of India. Univoltine summer species with rather long flight

Fig. 3. *Apamea norbertkeili* sp. n., genitalia, RL12935m, Holotype, Nepal, Annapurna Himal.

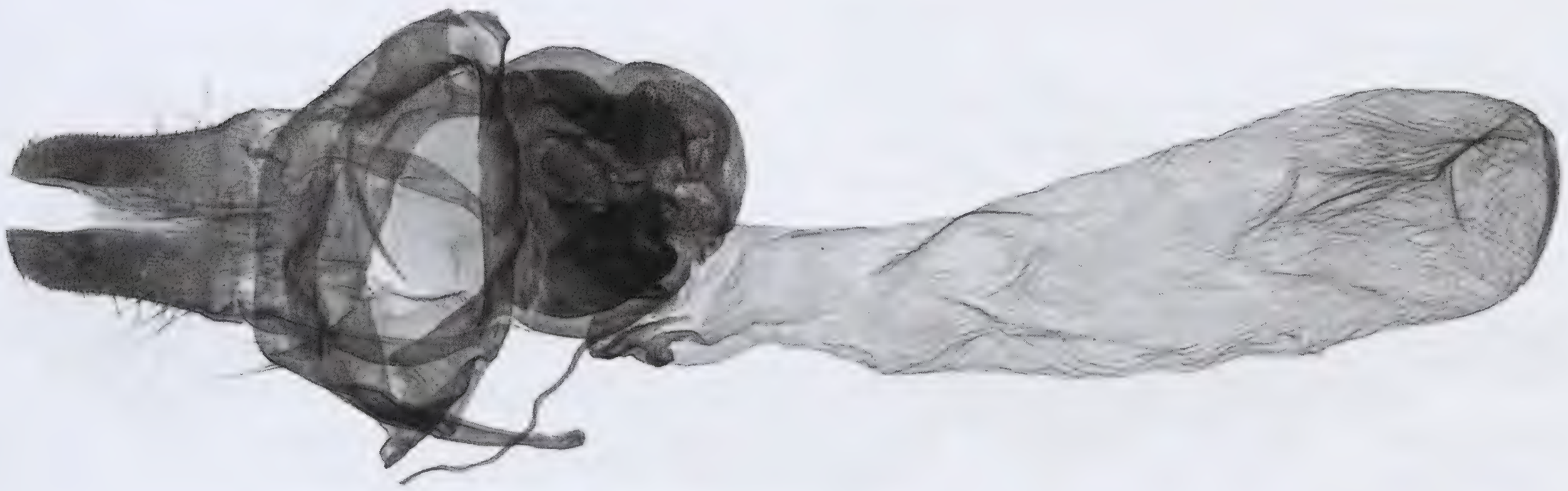


Fig. 4. *Apamea norbertkeili* sp. n., genitalia, MHNG-ENTO-0067512, Paratype, Nepal, Solu Khumbu Himal.

period, the majority of the specimens were collected in June and July but a rather fresh specimen was found at the beginning of October in the Annapurna range. The moths inhabit the high and very high altitude regions from the upper edge of the forest belt (ca 2800 m) to the subalpine grasslands up to 4000 m elevations.

Etymology: The new species is dedicated to Norbert Keil (Dachau, Germany), explorer of the Eurasiatic Noctuoidea fauna with special reference to the central Tien Shan region.

Remarks: The holotype of *A. norbertkeili* is erroneously illustrated in the 3rd volume of the Witt Catalogue (Zilli *et al.,* 2009: 208, plate 54, fig. 7) as *A. fasciata*. From the paratypes of *A. norbertkeili*, four specimens are shown on this plate as *A. fasciata* in figs 8-11.

***Apamea stangelmaieri* sp. n.**

Figs 5-6, 17-18

Holotype: Female, "Nepal, 4 km SW of Kalinchok peak, 3000 m, 07.VIII.1995, 86°01'E, 27°24'N, leg. Márton Hreblay & Tibor Csővári", MHNG-ENTO-0067517 (coll. MHNG).

Paratypes

Nepal. Rolwaling Himal, Kalinchok area. 4 ♀, with same data as holotype, MHNG-ENTO-0067513, 0067514, 0067515, and 0067516 (coll. MHNG). – 1 ♀, 6 km SW of Kalinchok peak, 3160 m, 27°23'N, 86°00'E, 6.AUG.1995, leg. T. Csővári & M. Hreblay, slide No. RL12940f (coll. T. Csővári, Budapest). – 1 ♀, 6 km NNE of Muldi (Murree) 2835 m, 05.AUG.1995, 27°23'N, 85°58'E, leg. M. Hreblay & T. Csővári, MHNG-ENTO-0067518 (coll. MHNG). – 1 ♀, with same locality and data, slide No. RL9650f (coll. T. Csővári, Budapest).

Fig. 5. *Apamea stangelmaieri* sp. n., genitalia, MHNG-ENTO-0067506, Paratype, India, West Bengal.

Fig. 6. *Apamea stangelmaieri* sp. n., genitalia, MHNG-ENTO-0067518, Paratype, Nepal, Kalinchok Himal.

Kanchenjunga Himal. 1 ♂, 2 km S of Ghunsa, 3600 m, 24.JUN.1998, leg. B. Benedek & M. Hreblay, Slide No. AZ1320m (coll. HNHM).

India. West Bengal. 1 ♂, Tiger Hill, 2573 m, MHNG-ENTO-0067506 (coll. MHNG).

Diagnosis: *Apamea stangelmaieri* is easily separable from the other members of the species complex by its comparatively shorter and broader, apically finely rounded forewings, the most extensive and generally unicolorous pale bluish ashy-grey basal and submarginal suffusion and the palest hindwings; this is the smallest continental Asiatic species of the *Apamea fasciata* species group with its wingspan 33-36 mm.

The male genitalia of *A. stangelmaieri* (Fig. 5) can be distinguished from *A. fasciata* (genitalia Fig. 1) and *A. norbertkeili* (Fig. 3) by the armature of the vesica which is composed from one or two robust, broad-based cornutus (cornuti) while the other two species have, besides the two large cornuti a third, subbasal, conical cornutus. *Apamea stangelmaieri* differs also from the two relatives by the configuration of the distal end of aedeagus which is less curved than in the other two taxa and the carinal tooth is positioned ventrally while it is dorsal in *A. fasciata*.

The female genitalia of *A. stangelmaieri* (Fig. 6) are similar to those of *A. fasciata* (Fig. 2) and *A. norbertkeili* (Fig. 4) but the antrum-ductus bursae complex is considerably smaller, rather cup-shaped, lacking the rounded anterior (proximal) lobe, therefore the rather symmetrical internal sclerotised plates exceed the anterior edge of ductus bursae.

Distribution: The new species has a rather limited range in the eastern part of the southern Himalayan massif in Nepal and India, extending from the

Kalinchok area (east from Kathmandu) through the Kanchenjunga massif to the Darjeeling region in West Bengal. The moths are on the wing in the midsummer period, inhabiting the medium-high forested belts between 2500-3000 m altitudes.

Etymology: The new species is dedicated to Günter Stangelmaier (Villach, Austria), famous explorer of the European and western Asiatic Noctuoidea fauna.

Remarks: A male paratype of *A. stangelmaieri* is erroneously illustrated in the 3rd volume of the Witt Catalogue (Zilli *et al.,* 2009: 208: plate 54, fig. 6) as *A. fasciata* and its proper locality is in the Kanchenjunga Himal (see above in the list of paratypes).

Apamea bernhardmayi sp. n.

Figs 7, 21-22

Holotype: Female, "Khasis. Nat. Coll.", "Collectio H. J. Elwes", "NHMUK 010354066" (with QR code), slide No. RL11771f (coll. NHM UK).

Paratypes

India. Khasia Hills (Khasis). 2 ♀, "Euplexia fasciata Leech", "6444 Khasia Hills", "NHMUK 010354066" and "NHMUK 010354068" (with QR codes) (coll. NHM UK).

Diagnosis: The new species occurring in the Khasia Hills represents the largest known member of the species group; its wingspan is 41-45 mm. *Apamea bernhardmayi* has, comparing with the other species of the group, the longest and apically most pointed forewings with the weakest light greyish markings, reduced to the narrow stripe in the submedian fold, the narrow inner part of marginal field, the light patch of termen and the thin subterminal line.

The female genitalia of *A. bernhardmayi* (Fig. 7) are most similar to those of the insular sister species, *A. ploessli* (Figs 8, 9) due to their narrow but broad, collar-like antrum and long, partly tubular, partly swollen and rugose-ribbed ductus bursae. *Apamea bernhardmayi* differs from *A. ploessli* by its slenderer ovipositor with anteriorly less dilated papillae anales, weaker apophyses anteriores, longer and much stronger ribbed swollen anterior (proximal) section of ductus bursae extending further into posterior tubular section of corpus bursae aside appendix bursae, and the more membranous, less scobinate-wrinkled appendix bursae.

Distribution: The new species in supposedly endemic to the Khasia Hills. Nothing more is known about the habitat or the phaenology, only the locality is given on the specimens collected more than hundred years ago.

Etymology: The new species is dedicated to Mr Bernhard May (Munich, Germany), explorer of the Eurasiatic moth fauna with special reference to the Mediterranean region and the central Tien Shan massif.

Apamea ploessli sp. n.

Figs 8-9, 23-24

Holotype: Female, "TAIWAN, HOHANSHAN, Hualien Co., Alt. 3300 m, 19/21-VI-1993, F. Aulombard et J. Plante", MHNG-ENTO-0067523 (coll. MHNG).

Paratypes

Taiwan. Hualien County. 3 ♀, with same data as holotype, MHNG-ENTO-0067524, 0067525, and 0067526 (coll. MHNG).

Ilan County. 1 ♀, Suyuan, near Pinan, at the road 7/1, 1550 m, 09.MAY.1997, leg. Gy.M. László & G. László (coll. G. Ronkay, NHMW). – 1 ♀, from the same site, 06.JUN.1997, leg. B. Herczig & L. Ronkay (coll. G. Ronkay, NHMW).

Taoyuan County. 1 ♀, Ming Chyr Forest Recreation Area, 1160 m, 17-18.APR.1997, leg. Gy. Fábián & S. Kovács, slide No. RL9957f (coll. Gy. Fábián, Budapest; paratype of *A. herczigi*). – 1 ♀, from same locality, 08-09. JUL1997, leg. S.T. Kovács (coll. S.T. Kovács, Szeged; paratype of *A. herczigi*).

Nantou County. 1 ♀, 5 km N of Shihmen, Hohuan Pass, 3000 m, 22.SEP.2006, leg. H.R. Tzuoo (coll. H.R. Tzuoo, Puli; paratype of *A. herczigi*). – 1 ♀, Shenmu, 1200 m,

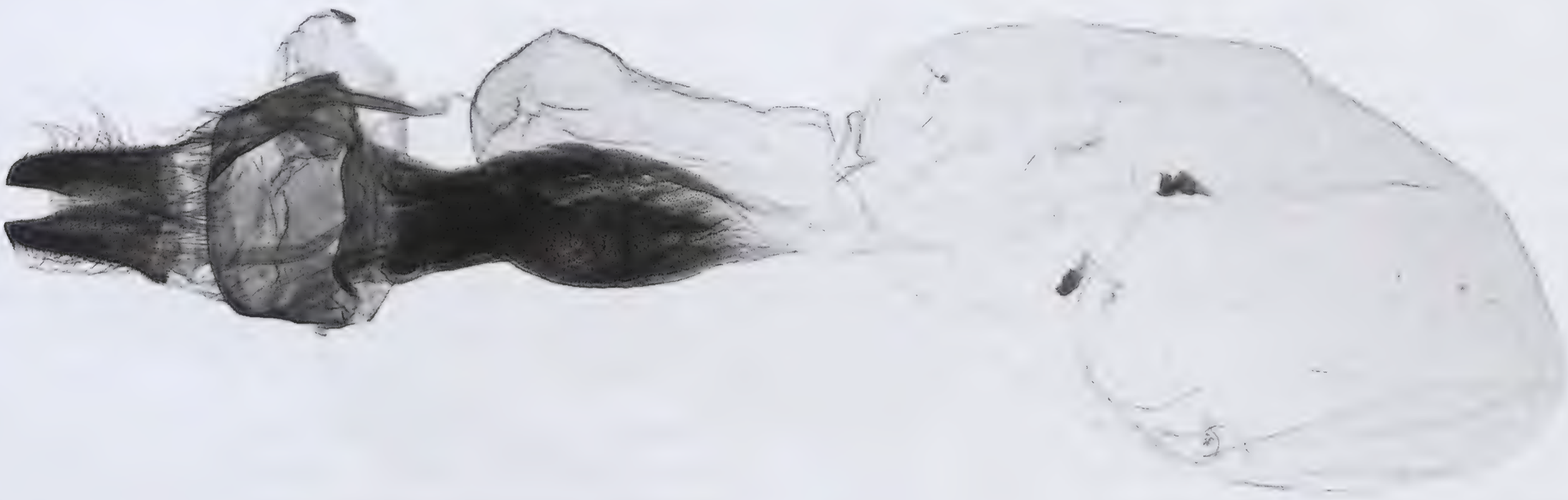


Fig. 7. *Apamea bernhardmayi* sp. n., genitalia, RL11771f, Holotype, Khasis.

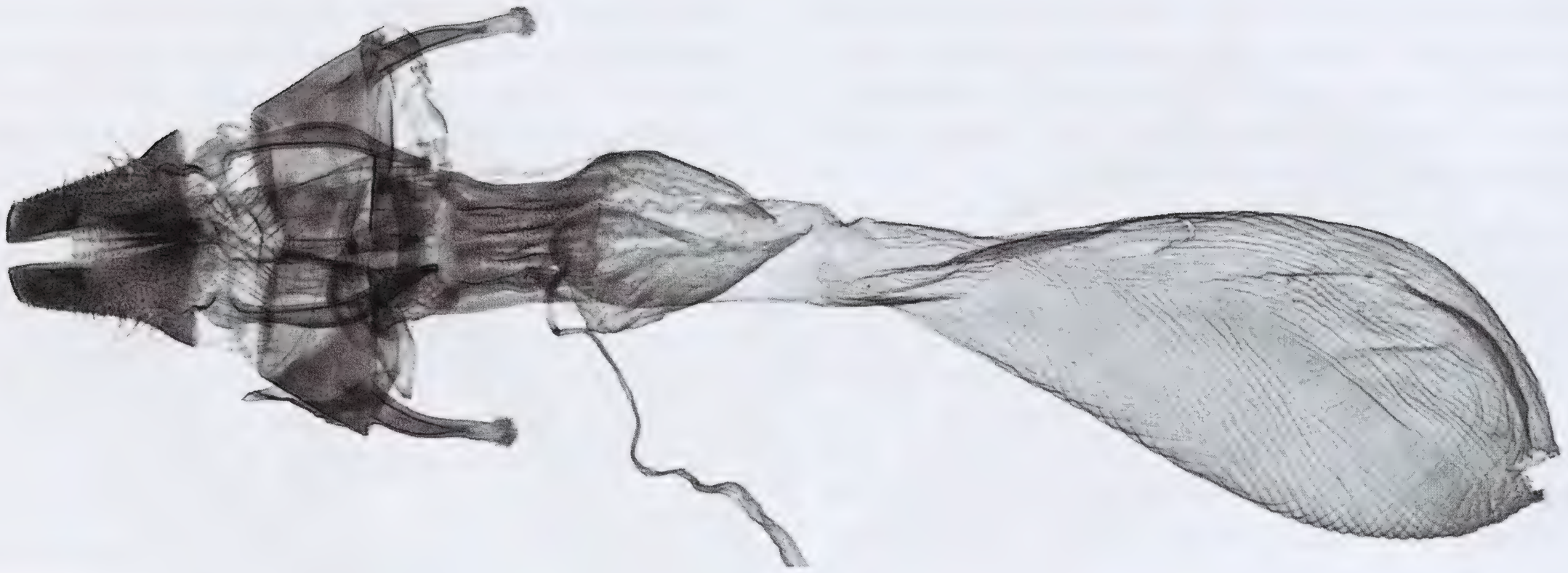


Fig. 8. *Apamea ploessli* sp. n., genitalia, MHNG-ENTO-0067524, Paratype, Taiwan.

Fig. 9. *Apamea ploessli* sp. n., RL9957f, genitalia, Paratype, Taiwan.

24.SEP.1994, leg. H.R. Tzuoo (coll. H.R. Tzuoo, Puli; paratype of *A. herczigi*).
Chiayi County. 1 ♀, Fenchifu, 25-26.MAY.1986, leg. C.S. Lin, No. 65-91 (coll. NMNS, paratype of *A. herczigi*).

Diagnosis: *Apamea ploessli* is the insular sister species of *A. bernhardmayi* despite the easily recognisable external differences. It is smaller in size than its twin species (wingspan 35-39 mm vs 41-45 mm, respectively), having broader and apically less pointed forewings with prominent basal and submarginal bluish ashy-grey suffusion. It resembles mostly *A. norbertkeili* and *A. stangelmaieri* but the characteristic straight grey patch in the submedian fold and the less variegated dark red-brown median area (and the locality data) help in the separation of *A. ploessli* from the externally similar relatives.
The female genitalia of *A. ploessli* (genitalia Figs 8-9) differ from those of *A. bernhardmayi* (genitalia Fig. 7) by the anteriorly remarkably broader papillae anales, the thicker apophyses posteriores, the shorter ductus bursae with shorter and less ribbed-rugose swollen anterior (proximal) section and the stronger scobination of appendix bursae. These two species are easily distinguished by the female genitalia from the other two members of the *A. herczigi* lineage by the entirely tubular, anteriorly swollen ductus bursae while the anterior section of ductus bursae is enlarged and laterally dilated towards the posterior tubular part of corpus bursae and appendix bursae in *A. ericmetzleri* and *A. herczigi* (Figs 10 and 12, respectively).

Distribution: Endemic to Taiwan. The new species inhabits the meso-montane and montane forest belts between 1200-3300 m altitudes. The phaenology data would suggest a bivoltine rather than univoltine life cycle as the moths are on the wing from April to the beginning of July and in September and the species was found above 3000 m elevations in June and in September.

Etymology: The new species is dedicated to Bernhard Plössl (Innsbruck, Austria), explorer of the Eurasiatic Noctuoidea fauna with special reference to the central Tien Shan region and Iran.

Remarks: The species has long been confused with *A. herczigi,* the other Taiwanese endemic member of the *fasciata* species complex, therefore the type series of the latter taxon is mixed. The two species are, however, easily distinguished by their external features, too (see Figs 23, 24 and 27,28), therefore the proper identification does not requires the study of the genitalia.

It is worth to note that the male of *A. ploessli* is still unknown, despite the intensive collectings in the montane forest regions of Taiwan. It appears as a common feature of the species group, the majority of the collected specimens are females and three of the four members of the *herczigi* lineage are known only by the female sex.

Apamea ericmetzleri sp. n.

Figs 10, 25-26

Holotype: Female, Nepal, Ganesh Himal, Khurpudanda pass, NE slope, 28°10,5'N, 85°12'E, 36-3700 m, 13-16. MAY.1995, leg. Gy. Fábián & L. Ronkay, slide No. RL12939f (coll. G. Ronkay, NHMW).

Paratype

China. 1 ♀, Sichuan, Kinfushan, MAY-JUN.1929, coll. H. Becker, slide No. RL12967f (coll. NHMW).

Diagnosis: *Apamea ericmetzleri* is the continental Himalayan-Sino-Tibetan twin species of *A. herczigi* despite the rather conspicuous differences in their external appearance. It can be distinguished from the partly sympatrically occurring *A. norbertkeili* by its narrower and longer wings with somewhat more pointed forewings and the characteristic arcuate bluish-grey basal patch composed from a submedian stripe and the filling of the lower half of the double antemedial line; from *A. bernhardmayi* by the less pointed wings and the more prominent light greyish markings. Wingspan 38-41 mm.

The female genitalia of *A. ericmetzleri* (Fig. 10) are easily separable from those of *A. herczigi* (Fig. 12) by the longer and straighter, less heavily sclerotised tubular posterior section of ductus bursae and the conspicuously larger, laterally widely expanded rugose-ribbed swollen anterior section which covers the entire appendix bursae. The other two related species of the *herczigi* lineage have entirely straight, anteriorly swollen and much less ribbed-rugose ductus bursae and membranous-scobinate appendix bursae.

Distribution: Himalayan-Sino-Tibetan. The Nepalese holotype was collected in the subalpine zone above the shrubby *Rhododendron* belt in the Ganesh Himal, in an early spring aspect, together with the overwintering Himalayan Xyleninae species and the freshly emerged Orthosiini taxa. The habitat of the Sichuan specimen is unknown but it was also collected in the early spring.

Etymology: The new species is dedicated to Eric Metzler (Alamogordo, New Mexico, USA), expert of the Nearctic Noctuoidea.

Remarks: The new species has long been confused with the other two Himalayan relatives and the recognition of the distinctness of the Khasia Hills species intended the detailed investigation of the specimens having longer and narrower, apically more pointed forewings.

The two known specimens are found in two remote areas in the Himalayan-Sino-Tibetan region. Their female genitalia show certain differences but the material is insufficient to decide whether these differences are due to the individual variation or the two populations represent two distinct taxa, therefore the two specimens are treated here as conspecific.

Apamea herczigi Zilli, Varga, Ronkay & Ronkay, 2009

Figs 11-12, 27-28

Apamea herczigi Zilli, Varga, Ronkay & Ronkay, 2009: 108, figs 30: 3-4, 54: 13-16, 116.

Type material examined: Holotype ♂, Taiwan, Nantou County, 5 km N Shihmen, Hohuan Pass, 3000 m,

Fig. 10. *Apamea ericmetzleri* sp. n., RL12939f, genitalia, Holotype, Nepal, Ganesh Himal.

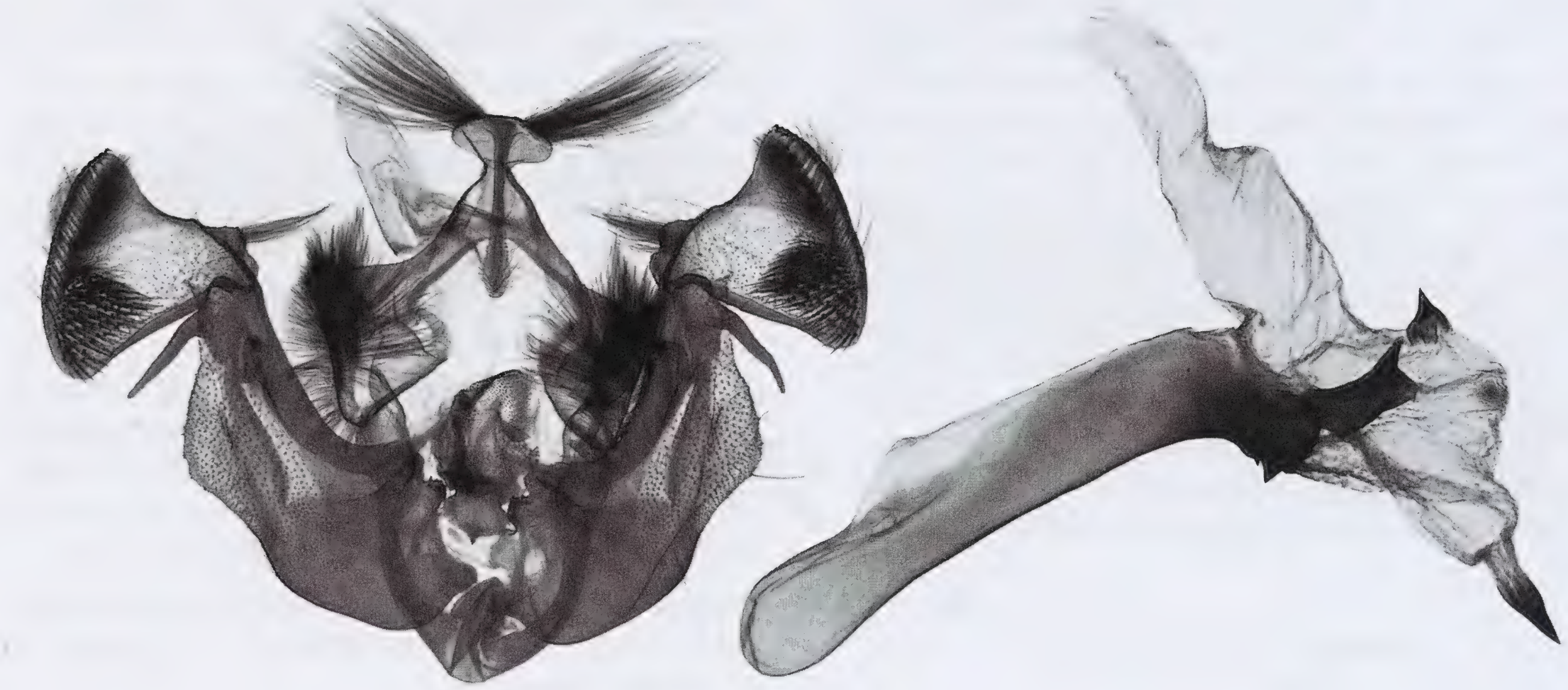


Fig. 11. *Apamea herczigi* Zilli, Varga, Ronkay & Ronkay, 2009, genitalia, BJ883m, Holotype.

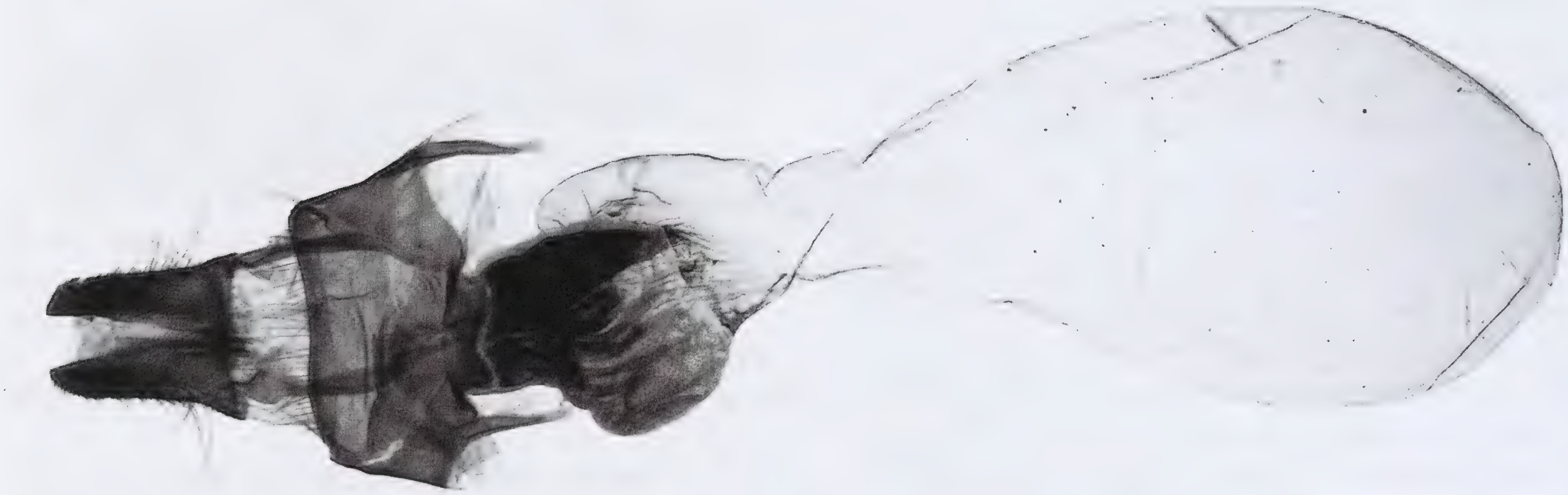


Fig. 12. *Apamea herczigi* Zilli, Varga, Ronkay & Ronkay, 2009, genitalia, RL9956m, Paratype, Taiwan.

12.JUL.1996, leg. G. Csorba & L. Németh, slide No. BJ883m (coll. G. Ronkay, NHMW). The slide number of the holotype is erroneously published in the original description as "BJ880" but correctly indicated as "BJ883" on the genitalia plate 116 (Zilli *et al.,* 2009: 334).

Paratypes. Taiwan. Nantou County. 3 ♀, with same data as holotype, slide Nos AZ1322f, BJ884f, and RL9956f (coll. HNHM, Gy. Fábián, Budapest & G. Ronkay, NHMW). – 1 ♀, 5 km SW Tayüling, 3000 m, 24°09'N, 121°17'E, 08-09.JUL.1997, leg. T. Csővári & L. Mikus, slide No. RL9649f (coll. T. Csővári, Budapest). Taoyuan County. – 1 ♀, Ming-Chyr Forest Recreation Area, 1160 m, 13-14.JUL.1996, leg. G. Csorba & L. Németh, slide No. BJ885f (coll. G. Ronkay, NHMW).

Additional material examined:

Taiwan. Hualien County. 1 ♀, Hohuanshan, 3300 m, 19-21.JUL.1993, leg. F. Aulombard & J. Plante, MHNG-ENTO-0067561 (coll. MHNG). – 1 ♀, Tayuling, Road to Hohuanshan, 3000 m, 21.JUN.1993, leg. F. Aulombard & J. Plante, MHNG-ENTO-0067562 (coll. MHNG).

Diagnosis: *Apamea herczigi* is the Taiwanese sister-species of *A. ericmetzleri* though it resembles externally mostly the Chinese *A. fasciata*. It differs from its continental relative by its smaller size due to its shorter and broader, apically less pointed forewings (wingspan 34-37 mm, vs 38-41 mm), and the more indistinct, less dense pale bluish-grey irroration on a more uniform brown ground. This diffuse and weak, less contrasting pale grey forewing pattern is a specific feature of *A. herczigi*, a somewhat similar composition of the

13

14

15

16

17

18

19

20

Figs 13-20. (13) *Apamea fasciata* (Leech, 1900), ♂, Lectotype, China, Sichuan (wingspan 39 mm). (14) *Apamea fasciata* (Leech, 1900) ♀, Paralectotype, China, Sichuan (wingspan 37 mm). (15) *Apamea norbertkeili* sp. n., ♂, Holotype, Nepal, Annapurna Himal (wingspan 41 mm). (16) *Apamea norbertkeili* sp. n., ♂, Paratype, Nepal, Annapurna Himal (wingspan 39 mm). (17) *Apamea norbertkeili* sp. n., ♀, Paratype, Nepal, Annapurna Himal (wingspan 37 mm). (18) *Apamea stangelmaieri* sp. n., ♀, Holotype, Nepal, Kalinchok Himal (wingspan 33 mm). (19) *Apamea stangelmaieri* sp. n., ♀, Paratype, Nepal, Kalinchok Himal (wingspan 35 mm). (20) *Apamea stangelmaieri* sp. n., ♀, Paratype, Nepal, Kalinchok Himal (wingspan 34 mm).

21

22

23

24

25

26

27

28

Figs 21-28. (21) *Apamea bernhardmayi* sp. n., ♀, Holotype, Khasis (wingspan 45 mm). (22) *Apamea bernhardmayi* sp. n., ♀, Paratype, Khasis (wingspan 42 mm). (23) *Apamea ploessli* sp. n., ♀, Holotype, Taiwan (wingspan 38 mm). (24) *Apamea ploessli* sp. n., ♀, Paratype, Taiwan (wingspan 37 mm). (25) *Apamea ericmetzleri* sp. n., ♀, Holotype, Nepal, Ganesh Himal (wingspan 38 mm). (26) *Apamea ericmetzleri* sp. n., ♀, Paratype, China, Sichuan (wingspan 41 mm). (27) *Apamea herczigi* Zilli, Varga, Ronkay & Ronkay, 2009, ♂, Holotype, Taiwan (wingspan 35 mm). (28) *Apamea herczigi* Zilli, Varga, Ronkay & Ronkay, 2009, ♀, Paratype, Taiwan (wingspan 35 mm).

forewing pattern can be recognised only in the Indian Himalayan *A. bernhardmayi*.

The diagnostic features of the male genitalia (Fig. 11) are, in comparison with the species of the *A. fasciata* lineage, the stronger, distally more dilated uncus, the strongly dentate ventral and flat, rounded dorsal prominence of clavus, the wider, more rounded ventral half of the cucullus and the structure of the aedeagus and the vesica. The aedeagus is longer, thinner and straighter, the ventral part of the carina is more curved, forming large, sclerotised dentate plate, the vesica is more projecting forward and ventrally, and is armed by a large and broad-based subbasal cornutus and two much smaller, bulbed cornuti, one of them terminating a tubular postero-ventral diverticulum.

The female genitalia of *A. herczigi* (Fig. 12) differ from those of *A. ericmetzleri* (Fig. 10) by the much shorter but stronger sclerotised tubular posterior section of ductus bursae and the smaller and laterally less expanded rugose-ribbed swollen anterior section which does not cover the entire appendix bursae as in its sister taxon.

Distribution: Endemic to Taiwan. The species inhabits the medium-high and high forest belts of the island; the adults are on the wing in the midsummer period.

Remarks: The type series of *A. herczigi* is mixed with the preceding Taiwanese species in the original description; see also under the Remarks of *A. ploessli*. *Apamea herczigi* is the only species of the *herczigi* lineage which is represented by both sexes; the male and the female are practically identical externally.

ACKNOWLEDGEMENTS

We are indebted to Martin R. Honey and Geoff Martin (London, England), Martin Lödl and Sabine Gaal-Haszler (Vienna, Austria), Dieter Stüning (Bonn, Germany), Axel Hausmann and Ulf Buchsbaum (Munich, Germany), and Jacques Ayer (Geneva, Switzerland) for their help during the study of the type material preserved in the collections of their institutions.

Our special thanks to Tibor Csővári and György Fábián (Budapest, Hungary), Péter Gyulai and Adrienne Garai-Gyulai (Miskolc, Hungary), Béla Herczig (Baj, Hungary), Oleg Pekarsky (Budapest, Hungary) and Zoltán S. Varga (Debrecen, Hungary) for their kind support of our studies. We are especially grateful to Martin Lödl and Sabine Gaal-Haszler (Vienna, Austria), Mária Tóth-Ronkay (Budapest, Hungary), and Ádám Kiss (Gyöngyös, Hungary) for their immense and essential help in the microscopic photography and the continuous support of our work.

This research was supported by the Jacques Plante Noctuidae Collection Project which is financed by the Muséum d'histoire naturelle, Geneva, and the SYNTHESYS Project which is financed by European Community Research Infrastructure Action under the FP6 "Structuring the European Research Area" Programme (Grants Nos AT-TAF-5609, DE-TAF-3514 and GB-TAF-2644 for G. Ronkay and FR-TAF-562, GB-TAF-2656, GB-TAF-5870 and SE-TAF-6919 for L. Ronkay).

REFERENCES

Chang B.S. 1991. *Illustration of Moths in Taiwan 5*. Taiwan Museum, Taipei. 366 pp.

Chen Y. 1999. Noctuidae. *Fauna Sinica*, Insecta vol. 16, Lepidoptera, Noctuidae. Science Press, Beijing, lxxiii + 1596 pp., pls 1-68.

Draudt M. 1950. Beiträge zur Kenntnis der Agrotiden-Fauna Chinas. Aus den ausbeuten Dr H. Höne's (Beitrag zur Fauna Sinica). *Mitteilungen der Münchner Entomologischen Gesellschaft* 40: 1-174, 18 plates.

Fu C.M., Tzuoo H.R. 2002. *Moths of Anmashan* Part 1. Taichung Nature Research Society Taichung, 163 pp.

Fu C.M., Tzuoo H.R. 2004. *Moths of Anmashan* Part 2. Taichung Nature Research Society Taichung, 263 pp.

Fibiger M., Goater B. 1997. Technique for making preparations of genitalia, pages 14-17. *In*: Fibiger M. Noctuinae III. Noctuidae Europaeae 3. *Entomological Press, Sorø.*

Hampson G.F. 1908. Catalogue of the Lepidoptera Phalaenae in the collection of the British Museum. 7. Acronyctinae. *Trusteees of the British Museum, London,* xv + 709 pp.

Hreblay M., Ronkay L., Plante J. 1998. Contribution to the Noctuidae (Lepidoptera) fauna of Tibet and the adjacent regions (II). A systematic survey of the Tibetan Noctuidae fauna based on the material of the Schäfer-expedition (1938-1939) and recent expeditions (1993-1997) (Lepidoptera: Noctuidae). *Esperiana* 6: 69-184.

Leech J.H. 1900. Lepidoptera Heterocera from northern China, Japan and Corea. Part. 3. *Transactions of the Entomological Society of London* 1900: 9-161.

Ochsenheimer F. 1816. Die Schmetterlinge von Europa. Volume 4. *Gerhard Fleischer, Leipzig.* 224 p.

Owada M. 1992. Noctuidae. *In:* Heppner J.B., Inoue H. (eds), *Lepidoptera of Taiwan,* Part 2: Checklist. *Association for Tropical Lepidoptera, Gainesville,* 276 pp.

Robinson G.S. 1976. The preparation of slides of Lepidoptera genitalia with special reference to the Microlepidoptera. *Entomologist's Gazette* 27: 127-132.

Warren E. 1909-1914. *In:* Seitz A. (ed.), Eulenartige Nachtfalter. Die Gross-Schmetterlinge der Erde, I. Abteilung. Die Gross-Schmetterlinge des Palaearktischen Faunengebietes. Stuttgart. 511 pp.

Zilli A., Ronkay L., Fibiger M. 2005. Apameini. Noctuidae Europaeae 8. *Entomological Press, Sorø,* 323 pp.

Zilli A., Varga Z., Ronkay G., Ronkay L. 2009. Apameini I. The Witt Catalogue. A Taxonomic Atlas of the Eurasian and North African Noctuoidea. Volume 3. *Heterocera Press, Budapest.* + 393 pp.

Revue suisse de Zoologie (September 2022) 129(2): 343-367 ISSN 0035-418

The woodlice of Switzerland (Crustacea, Isopoda, Oniscidea), with 6 new records from heated greenhouses

Julio Cifuentes[1], José D. Gilgado[2,3]* & Ian Bobbitt[2]

[1] *Departamento de Biología (Zoología), Facultad de Ciencias, Universidad Autónoma de Madrid, E-28049 Cantoblanco, Madrid, Spain*

[2] *Section of Conservation Biology, University of Basel, St. Johanns-Vorstadt 10, CH-4056 Basel, Switzerland*

[3] *Grupo de Investigación de Biología del Suelo y de los Ecosistemas Subterráneos, Departamento de Ciencias de la Vida, Facultad de Biología Ciencias Ambientales y Química, Universidad de Alcalá, Ctra. Madrid – Barcelona, km. 33,6. A.P. 20. E-28805 Alcalá de Henares, Madrid, Spain*

* *Corresponding author: josedomingo.gilgado@uah.es*

Abstract: Woodlice (Isopoda: Oniscidea) represents a group of arthropods that has been neglected in Switzerland. The last comprehensive review on Swiss woodlice was published more than a century ago. In the present work, we update the checklist of woodlice in Switzerland and provide information on the distribution of each species as well as further remarks. We considered information on recent records of woodlice from different regions and habitats of Switzerland and present new species records, which are mainly based on a survey of heated greenhouses in nine botanical gardens and other institutions across Switzerland and a field survey in the Swiss National Park. Altogether, we found six new species for Switzerland. Five of them are exotic species, captured so far exclusively in heated greenhouses: *Reductoniscus costulatus* Kesselyák, 1930, *Venezillo parvus* (Budde-Lund, 1885), *Chaetophiloscia cellaria* (Dollfus, 1884), *Nagurus cristatus* (Dollfus, 1889), *Buddelundiella cataractae* Verhoeff, 1930b, and *Miktoniscus linearis* (Patience, 1908). Thus, the updated checklist of terrestrial woodlice in Switzerland comprises 50 species.

Keywords: Woodlice, Switzerland, Checklist, heated greenhouses, exotic species, new records.

INTRODUCTION

Woodlice (Isopoda: Oniscidea) constitute a group of crustaceans with more than 3500 described species worldwide (Schmalfuss, 2003). Woodlice show a cosmopolitan distribution, occurring in habitats situated close to the sea level and up to high elevations. Woodlice are mainly saprophagous, thereby playing an important role in the recycling of nutrients in the soil (Hornung, 2011). The first reference to Swiss woodlice was given by Am Stein (1857), who reported 11 species from the canton Grisons. Almost two decades later, Pavesi (1873) added another species from canton Tessin to the list of Swiss woodlice. In subsequent works, Dollfus (1892, 1897a, b) reported 10 further species from Switzerland, and Verhoeff (1896, 1900, 1908a, 1931, 1938) another five. Carl (1906, 1908a) added further 13 species, and later Vandel (1960) and Strouhal (1964) added another three species each. The last additions to the Swiss checklist of woodlice were published in the 21st century, in the works of Schmalfuss (2003), Cochard *et al*. (2010) and Vilisics *et al*. (2012), who added one species each. Thus, 49 woodlice species have been reported from Switzerland so far. In addition, there are records of two species from museum material published only in GBIF, one of them doubtful. It is noteworthy that the last comprehensive revision of the Swiss woodlice was published more than a century ago (Carl, 1911). Recently, some works including records of woodlice from Switzerland have been published (Vilisics *et al.,* 2012; Hollier, 2018; Braschler *et al.,* 2020), and the Centre Suisse de Cartographie de la Faune (CSCF) has made an effort to gather all published and unpublished records of Swiss woodlice. All these records have been checked and validated by Pascal Stucki (Yves Gonseth, pers. com.) and are available upon request (http://www.cscf.ch). A checklist provides an overview of the diversity and the number of native and non-native species of a taxonomical group in a certain region, and sets a baseline for conservation management. Thus, checklists are not only necessary for biogeographical studies, they are also an important tool for conservation measures.

Manuscript accepted 22.06.2022
DOI: 10.35929/RSZ.0081

Human activities are promoting the disperal of non-native, and even invasive arthropod species in Europe, also in Switzerland (Wittenberg, 2005). One of the main pathways for the dispersal of non-native species is the international trade of plants (Cochard *et al*., 2010). Traded plants frequently contain arthropods attached to the soil in their roots (Cochard *et al*., 2010). Plant nurseries, botanical gardens and heated greenhouses constitute therefore a suitable target for an early detection of non-native species. Studies on woodlice in heated greenhouses are not abundant worldwide. Some relevant examples are those of Bagnall (1909) in Ireland, Holthuis (1945) in the Netherlands, Holthuis (1947, 1948) in the United Kingdom, and more recently of De Smedt *et al.* (2017) in Belgium and Carpio-Díaz *et al.* (2018) in Colombia. In Switzerland, only Holzapfel (1932) examined woodlice in the heated greenhouses of the Botanical Garden of Bern and reported the occurrence of nine species: *Androniscus dentiger* Verhoeff, 1908a, *Armadillidium nasatum* Budde-Lund, 1885, *Haplophthalmus danicus* Budde-Lund, 1880, *Haplophthalmus mengii* (Zaddach, 1844), *Hyloniscus riparius* (C.L. Koch, 1838), *Oniscus asellus* Linnaeus, 1758, *Porcellio scaber* Latreille, 1804, *Trachelipus rathkii* (Brandt, 1833) and *Trichoniscus pygmaeus* Sars, 1898. All these species seem to have a European origin, with *P. scaber* being the only one probably non-native, coming from southern Europe (Vandel, 1946, 1962). Beyond heated greenhouses, the woodlice fauna of Swiss botanical gardens has been presented in several articles. In particular, Carl (1908a, 1911) reported *Armadillidium nasatum* Budde-Lund, 1885 from the Botanical Garden of Bern, *Androniscus roseus* (C. Koch, 1838) and *Hyloniscus riparius* (C. Koch, 1838) from the Botanical Garden of Geneva, *Androniscus dentiger* Verhoeff, 1908a from the Garden of Jonction (Geneva), and *Haplophthalmus mengii* (Zaddach, 1844) and *Hyloniscus riparius* from the Botanical Garden of Zurich. The present work has two aims: First, we provide updated data of the woodlice fauna of heated greenhouses in Switzerland including records of six new species, and second, we present an updated checklist of the woodlice of Switzerland with details of their known distribution.

MATERIAL AND METHODS

A literature search was made to gather published records of woodlice in Switzerland. We used the catalogue of Schmalfuss (2003) as a starting point, and checked all the references and corresponding literature dealing with Swiss woodlice. We also searched for published works on swiss terrestrial isopods in platforms like Google Scholar (https://scholar.google.com), ResearchGate (https://www.researchgate.net), Gallica (https://gallica.bnf.fr), and searched for woodlice records in platforms like GBIF (https://www.gbif.org). We did not take into account records based solely on photographs in online citicen science platforms, such as iNaturalist (https://www.inaturalist.org). These identifications are in many cases doubtful, since for a reliable species identification it is necessary to examine morphological features under the microscope. We found a total of 20 references with 962 records from around 200 localities. The woodlice records from the survey made by Braschler *et al.* (2020) in gardens of Basel area did not include detailed information about the location of each garden. These gardens were located in the cantons of Basel-Stadt (Gardens 1, 2, 4, 6, 8, 27 and 34), Basel-Landschaft (Gardens 5, 7, 9–26, 28–33 and 35) and Solothurn (Garden 3), and locality information of these woodlice records is provided in the present work.

We also considered woodlice recorded in two recent surveys (one in heated greenhouses across Switzerland, and one in the Swiss National Park, Grisons), as well as woodlice obtained from sporadical samplings (a scree slope in Gempen, Solothurn, and in the Bueberg Kaverne, Laufen, Basel-Landschaft). We searched for woodlice in heated greenhouses in nine institutions across Switzerland (Table 1): Botanical Garden of Basel University, Basel Zoo, Botanical Garden of the University of Bern, Conservatory and Botanical Garden of the City of Geneva, Botanical Garden of St. Gallen, Botanical Garden of the University of Fribourg, Botanical Garden of the University of Zurich, the Jurassica Botanical Garden (Porrentruy), and the Papiliorama Tropical Garden in Kerzers. The greenhouses were visited between June and December 2019. In each greenhouse two methods for invertebrate sampling were used: active search (30 minutes per greenhouse) and pitfall trapping (56 trap days per greenhouse). At localities where more than one greenhouse was present (Porrentruy, Geneva, Zurich, and Fribourg), we used both sampling methods in the greenhouse that had the highest air temperature and humidity, and only applied active search in the other one (see details in Gilgado *et al.,* 2022a). In the Swiss National Park, we used pitfall traps to collect woodlice in four sampling localities in Val Trupchun and the lower parts of Val Müschauns, S-chanf, Grisons, in summer of 2018 (for sampling details see Gilgado *et al*., 2022b).

Specimens were identified by comparison of external morphology and/or sexual characters, by using keys of identification and the original descriptions or redescriptions. Photos were taken using a KEYENCE VHX-6000 microscope. The specimens collected in the greenhouses are stored in the Naturhistorisches Museum Basel, and those from the Swiss National Park are deposited in the collection of the Bündner Naturmuseum in Chur (Grisons, Switzerland). The synonyms of the species are not included in the systematic part because they have been already compiled by Schmalfuss (2003). Canton names are written in the accepted English form, which is not always a translation (Basel-Stadt is not "Basel-City"). Toponymy has been adapted or translated

Table 1. Names, location, and dates of visit of the greenhouses examined. The asterisk indicates additional active captures (not standardized).

Institution	Locality, Canton	Greenhouse	Code	Coordinates	Date 1	Date 2
Basel Zoo	Basel, Basel-Stadt	Altes Vogelhaus (Old bird house)	BZV	47°32'53.56"N, 7°34'43.13"E	3.10.19	10.10.19
Botanical Garden of St. Gallen	St. Gallen, St. Gallen	Tropischer Regenwald (Tropical rainforest)	SGR	47°26'24.12"N, 9°24'24.44"E	2.10.19	9.10.19
		Tropische Nutzpflanzen (Tropical cultures)*	SGN	47°26'24.50"N, 9°24'25.15"E	2.10.19	9.10.19
Botanical Garden of the University of Basel	Basel, Basel-Stadt	Tropenhaus (Tropical house)	BAT	47°33'31.06"N, 7°34'54.36"E	26.6.19	3.7.19
Botanical Garden of the University of Bern	Bern, Bern	Palmenhaus (Palm house)	BEP	46°57'8.99"N, 7°26'44.26"E	4.12.19	11.12.19
Botanical Garden of the University of Fribourg	Fribourg, Fribourg	Forêt tropicale (Tropical forest)	FRF	46°47'35.42"N, 7° 9'18.17"E	23.10.19	30.10.19
		Plantes utiles tropicales (Tropical useful plants)*	FRP	46°47'33.70"N, 7° 9'21.26"E	23.10.19	30.10.19
Botanical Garden of the University of Zurich	Zurich, Zurich	Tropischer Tieflandregenwald (Tropical lowland forest)	ZUT	47°21'28.45"N, 8°33'42.59"E	5.12.19	12.12.19
		Tropischer Bergwald (Tropical mountain forest)*	ZUB	47°21'28.49"N, 8°33'41.14"E	5.12.19	12.12.19
Conservatory and Botanical Garden of Geneva	Geneva, Geneva	Serre Tropicale Principale (Main Tropical Greenhouse)	GEP	46°13'31.44"N, 6° 8'43.07"E	15.10.19	22.10.19
		Jardin d'hiver (Winter garden)*	GEH	46°13'33.61"N, 6° 8'44.97"E	15.10.19	22.10.19
Jurassica Botanical Garden	Porrentruy, Jura	La Petite Serre Tropicale (The small tropical greenhouse)	JUP	47°24'48.78"N, 7° 4'36.89"E	7.11.19	14.11.19
		La Grande Serre Tropicale (The large tropical greenhouse)*	JUG	47°24'48.88"N, 7° 4'36.60"E	7.11.19	14.11.19
Papiliorama	Kerzers, Fribourg	Jungle Trek	PAP	46°59'24.05"N, 7°12'4.14"E	12.9.19	19.9.19

when necessary, and doubtful locations are commented. Sometimes two locations were mentioned with a dash indicating some points between them in the literature. We used the same criterion, except when they belonged to different cantons (e. g. "St. Gallen-Teufen"). In these cases we included both localities separately.

RESULTS

The results of the literature search complemented with new records from the greenhouses and other habitats resulted in a list of 51 valid species for Switzerland (Table 2). Six species previously listed to occur in the country had to be removed from the checklist (Table 3) because their validity has been questioned for different reasons: a *nomen dubium*, a *nomen nudum*, an assumed missidentification, a synonymy, and lack of evidence (see Discussion for details). The list of the CSCF includes four additional species whose records have not been published (Table 4). These five species are present in neighbouring countries, thus they are likely to be present in Switzerland and thus these records are probably correct. However, the lack of published information on the studied material, voucher specimens, capture localities, etc. prevents us from officially including them in the list.

The survey in heated greenhouses of Switzerland resulted in the capture of 1244 woodlice individuals, of which 1206 could be adscribed to 17 species. Six of the 17 species were recorded for the first time in Switzerland (Table 2). Greenhouses differed in species composition and abundance of woodlice (Table 5). The species number ranges from 0 species in the *Tropischer Regenwald* of the Botanical Garden of St. Gallen to 8 species in the *Palmenhaus* of the Botanical Garden of the University of Bern. The abundance ranges from 0 individuals in the *Tropischer Regenwald* of the Botanical Garden of St. Gallen to 567 individuals in the *Jungle Trek* of the Papiliorama (Table 2).

The survey in the Swiss National Park resulted only in the capture of one relatively common species, *Trachelipus ratzeburgii* (Brandt, 1833). The other two sporadical

Table 2. Checklist of woodlice in Switzerland, with the status of the species. An asterisk indicates that the species is a new record for Switzerland. *Ebelum* sp., reported in greenhouses, is not included because of its dubious determination.

Family		Species	Status
Agnaridae Schmidt, 2003	1	*Orthometopon planum* (Budde-Lund, 1885)	Resident
Armadillidae Brandt, 1833	2	*Reductoniscus costulatus* Kesselyák, 1930*	Exotic - Greenhouses only
	3	*Venezillo parvus* (Budde-Lund, 1885)*	Exotic - Greenhouses only
Family Armadillidiidae Brandt, 1833	4	*Armadillidium depressum* Brandt, 1833	Resident
	5	*Armadillidium nasatum* Budde-Lund, 1885	Resident
	6	*Armadillidium opacum* (C.L. Koch, 1841)	Resident
	7	*Armadillidium pictum* Brandt, 1833	Resident
	8	*Armadillidium pulchellum* (Zenker, 1798)	Resident
	9	*Armadillidium vulgare* (Latreille, 1804)	Resident
Cylisticidae Verhoeff, 1949	10	*Cylisticus biellensis* Verhoeff, 1930a	Resident
	11	*Cylisticus convexus* (De Geer, 1778)	Resident
Ligiidae Brandt, 1833	12	*Ligidium hypnorum* (Cuvier, 1792)	Resident
Oniscidae Latreille, 1802	13	*Oniscus asellus* Linnaeus, 1758	Resident
	14	*Oroniscus helveticus* Verhoeff, 1896	Resident
Philosciidae Kinahan, 1857	15	*Chaetophiloscia cellaria* (Dollfus, 1884)*	Introduced? (native to Southern Europe)
	16	*Lepidoniscus pruinosus* (Carl, 1908)	Resident
	17	*Philoscia muscorum* (Scopoli, 1763)	Resident
	18	*Tiroloscia exigua* (Budde-Lund, 1865)	Resident

Table 2. Continued

Family		Species	Status
Platyarthridae Verhoeff, 1949	19	*Platyarthrus hoffmannseggi* Brandt, 1833	Resident
	20	*Trichorhina tomentosa* (Budde-Lund, 1893)	Exotic - Synanthropic, commercially distributed
Porcellionidae Brandt & Ratzeburg, 1833	21	*Porcellio gallicus* Dollfus, 1904	Resident
	22	*Porcellio laevis* Latreille, 1804	Resident
	23	*Porcellio montanus* Budde-Lund, 1885	Resident
	24	*Porcellio scaber* Latreille, 1804	Resident
	25	*Porcellio spinicornis* Say, 1818	Resident
	26	*Porcellionides pruinosus* (Brandt, 1833)	Resident
Trachelipodidae Strouhal, 1953	27	*Nagurus cristatus* (Dollfus, 1889)*	Exotic - Greenhouses only
	28	*Porcellium conspersum* (C.L. Koch, 1841)	Resident
	29	*Trachelipus razzautii* (Arcangeli, 1913)	Resident
	30	*Trachelipus arcuatus* (Budde-Lund, 1885)	Resident
	31	*Trachelipus rathkii* (Brandt, 1833)	Resident
	32	*Trachelipus ratzeburgii* (Brandt, 1833)	Resident
Trichoniscidae Sars, 1898	33	*Androniscus dentiger* Verhoeff, 1908a	Resident
	34	*Androniscus roseus* (C.L. Koch, 1838)	Resident
	35	*Androniscus subterraneus* (Carl, 1906)	Resident
	36	*Buddelundiella cataractae* Verhoeff, 1930b*	Exotic - Greenhouses only
	37	*Calconiscellus gibbosus* Carl, 1908a	Resident
	38	*Haplophthalmus danicus* Budde-Lund, 1880	Resident
	39	*Haplophthalmus mengii* (Zaddach, 1844)	Resident
	40	*Haplophthalmus montivagus* Verhoeff, 1941	Resident
	41	*Hyloniscus riparius* (C.L. Koch, 1838)	Resident
	42	*Leucocyphoniscus verruciger* Verhoeff, 1900	Resident
	43	*Miktoniscus linearis* (Patience, 1908)*	Exotic - Greenhouses only
	44	*Trichoniscoides helveticus* (Carl, 1908a)	Resident
	45	*Trichoniscoides pulchellus* Legrand, 1950	Resident
	46	*Trichoniscus circuliger* Verhoeff, 1931	Resident
	47	*Trichoniscus noricus* Verhoeff, 1917b	Resident
	48	*Trichoniscus alemannicus* Verhoeff, 1917c	Resident
	49	*Trichoniscus provisorius* Racovitza, 1908	Resident
	50	*Trichoniscus pusillus* Brandt, 1833	Resident
	51	*Trichoniscus pygmaeus* G.O. Sars, 1898	Resident

Table 3. Species removed from the checklist, with the reasons for their removal.

Family	Species	Comments
Porcellionidae Brandt & Ratzeburg, 1833	*Porcellio alpinus* Am Stein, 1857	*Nomen dubium*.
	Porcellio monticola Lereboullet, 1853	Possible misidentification, according to Schmalfuss (2003). Absence of recent verified data.
	Porcellio pumicatus Budde-Lund, 1885	Doubtful identification. Absence of recent verified data. The species is known from Central Italy and Sardinia (Schmalfuss, 2003).
	Porcellio sylvestris Fabr	Possibly a *Nomen nudum*.
Trichoniscidae Sars, 1898	*Carloniscus dollfusi* (Carl, 1908b)	Possibly present in Switzerland, but no evidence available.
	Haplophthalmus perezi Verhoeff, 1941	Record questioned, synonym of *H. mengii*.

Table 4. Species present in the list of woodlice in Switzerland of the Centre Suisse de Cartographie de la Faune (CSCF) for which no published records are available.

Family	Species	Comments
Cylisticidae Verhoeff, 1949	*Cylisticus bergamotius* Verhoeff, 1928b	Recorded in Italy. Appears as *Cylisticus plumbeus* Verhoeff, 1901 in the CSCF list.
Mesoniscidae Verhoeff, 1908c	*Mesoniscus alpicola* (Heller, 1858)	Recorded in Austria, Germany and Italy.
Philosciidae Kinahan, 1857	*Philoscia affinis* Verhoeff, 1908d	Recorded in neighbouring countries.
Trachelipodidae Strouhal, 1953	*Trachelipus razzautii* (Arcangeli, 1913).	Appears as *Trachelipus larii* Verhoeff, 1927b in the CSCF list.

samplings, Bueberg-Kaverne and a scree slope in Dornach, also resulted in the capture of common species: *Oniscus asellus* Linnaeus, 1758 in both localities, and *Androniscus dentiger* and *Haplophthalmus mengii* in the Buerberg-Kaverne only.

Systematic part: woodlice in Switzerland

Family Agnaridae Schmidt, 2003
Genus *Orthometopon* Verhoeff, 1917a
Orthometopon planum (Budde-Lund, 1885)

Bibliographical records in Switzerland: Grisons: Brusio (Carl, 1911), Castasegna (Carl, 1908a, 1911), Misox Valley and Poschiavo (Carl, 1908a, 1911), Val Calanca (Carl, 1908a, 1911), Val Bregaglia (Carl, 1911), Misox Valley - Mesocco (Carl, 1911), Vicosoprano-Soglio (Carl, 1908a, 1911). **Tessin:** Leventina (Carl, 1908a, 1911), Lugano (Vilisics *et al*., 2012), Lugano-Carabbia (Carl, 1908a, 1911), Maroggia-Rovio (Carl, 1908a), Mendrisio (Carl, 1908a, 1911), Monte Brè (Carl, 1908a, 1911), Muzzano (Carl, 1908a, 1911), Val Blenio (Carl, 1908a). **Vaud:** Lausanne (Carl, 1908a, 1911). **Valais:** Brig (Verhoeff, 1938), Glarey (Carl, 1908a, 1911), Sion (Carl, 1911), Sierre (Carl, 1908a, 1911), Sitten (Carl, 1908a), Stalden (Verhoeff, 1938), Visp (Verhoeff, 1938).

Remarks: This species is also known from Croatia, Slovakia, France, Hungary and Italy (Schmalfuss, 2003).

Family Armadillidae Brandt, 1833
Genus *Reductoniscus* Kesselyák, 1930
Reductoniscus costulatus Kesselyák, 1930

Fig. 1A-C

Material examined: NMB; 1 male, 3 females; Switzerland, Basel-Stadt, Botanical Garden of the University of Basel, Tropenhaus, 47°33'31"N, 7°34'54"E, 270 m; 27.03.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 male, 4 females, 1 juvenile; Switzerland, Basel-Stadt, Basel Zoo, Vogelhaus, 47°32'53.56"N, 7°34'43.13"E, 278 m; 10.10.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 3 females, 1 broken; Switzerland, Bern, Botanical Garden of the University of Bern, Palmenhaus, 46°57'9"N, 7°26'44"E, 520 m; 11.12.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 female; Switzerland, Fribourg, Botanical Garden of the University of Fribourg, Forêt tropicale, 46°47'35.42"N, 7° 9'18.17"E, 631 m; 30.10.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 11 males, 57 females, 28 juveniles;

Table 5. Summary of the number of captured individuals of each species by greenhouse. (+) indicates that it was sampled during additional visual search. Abbreviations of the greenhouse names as in Table 1.

			Locality (Institution/greenhouse)																
Family	**Species**	**Total**	BZV	SG			BA		BE	FR		ZU		GE			JU		PAP
				SGR	SGN (+)	Outdoors	BAT	BAT (+)		FRF	FRP (+)	ZUT	ZUB (+)	GEP	GEH (+)	Outdoors	JUP	JUG (+)	
Armadillidae Brandt, 1833	*Reductoniscus costulatus* Kesselyák, 1930	**176**	6	—	—	—	—	4	4	1	—	48	—	96	—	—	—	—	17
	Venezillo parvus (Budde-Lund, 1885)	**520**	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	520
Armadillidiidae Brandt, 1833	*Armadillidium nasatum* Budde-Lund, 1885	**158**	—	—	—	—	—	17	85	—	—	—	2	27	17	—	4	6	—
Cylisticidae Verhoeff, 1949	*Cylisticus convexus* (De Geer, 1778)	**2**	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—
Eubelidae Budde-Lund, 1899	*Eubelum?* sp.	**2**	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Oniscidae Latreille, 1802	*Oniscus asellus* Linnaeus, 1758	**27**	—	—	—	—	—	—	10	—	—	—	17	—	—	—	—	—	—
Philosciidae, Kinahan, 1857	*Chaetophiloscia cellaria* (Dollfus, 1884)	**6**	—	—	—	—	3	3	—	—	—	—	—	—	—	—	—	—	—
	Chaetophiloscia sp.	**36**	—	—	—	—	—	—	—	—	—	—	—	33	3	—	—	—	—
Platyarthridae Verhoeff, 1949	*Trichorhina tomentosa* (Budde-Lund, 1893)	**26**	5	—	1	—	2	5	1	—	—	—	—	2	3	—	5	—	2
Porcellionidae Brandt & Ratzeburg, 1833	*Porcellio scaber* Latreille, 1804	**17**	—	—	—	4	1	1	6	—	3	—	2	—	—	—	—	—	—
	Porcellionides pruinosus (Brandt, 1833)	**18**	—	—	—	—	—	—	—	—	—	—	—	—	1	4	—	—	13
Trachelipodidae Strouhal, 1953	*Nagurus cristatus* (Dollfus, 1889)	**17**	—	—	—	—	—	—	1	2	—	5	—	—	—	—	—	—	9
	Trachelipus rathkii (Brandt, 1833)	**6**	—	—	—	6	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 5. Continued

Family	Species	Total	Locality (Institution/greenhouse)																
			BZV	SG			BA		BE	FR		ZU		GE			JU		PAP
				SGR	SGN (+)	Outdoors	BAT	BAT (+)		FRF	FRP (+)	ZUT	ZUB (+)	GEP	GEH (+)	Outdoors	JUP	JUG (+)	
Trichoniscidae Sars, 1898	*Androniscus dentiger* Verhoeff, 1908a	**15**	—	—	—	—	—	—	—	14	1	—	—	—	—	—	—	—	—
	Buddelundiella cataractae Verhoeff, 1930b	**135**	—	—	1	—	—	—	108	2	2	5	8	9	—	—	—	—	—
	Haplophthalmus danicus Budde-Lund, 1880	**39**	—	—	4	—	—	1	—	—	—	1	4	26	2	—	—	—	1
	Haplophthalmus mengii (Zaddach, 1844)	**4**	—	—	—	—	—	—	—	—	1	—	3	—	—	—	—	—	—
	Hyloniscus riparius (C. Koch, 1838)	**9**	—	—	—	—	—	1	1	1	3	—	—	3	—	—	—	—	—
	Miktoniscus linearis (Patience, 1908)	**31**	—	—	—	—	—	—	—	—	—	—	—	19	7	—	—	—	5

Switzerland, Geneva, Conservatory and Botanical Garden of Geneva, Serre Tropicale Principale, 46°13’31”N, 6°8’43”E, 389 m; 22.10.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 3 males, 9 females, 4 juveniles, 1 broken; Switzerland, Fribourg, Kerzers, Papiliorama, Jungle Trek, 46°59’24”N, 7°12’4”E, 438 m; 19.09.2019; Gilgado and I. Bobbitt leg. – NMB; 12 males, 32 females; Switzerland, Zurich, Botanical Garden of the University of Zurich, Tropischer Tieflandregenwald, 47°21’28”N, 8°33’42”E, 438 m; 12.12.2019; J.D. Gilgado and I. Bobbitt leg. – 2 males, 2 females; same data but in the collection of J.C.

Remarks: This species has been recorded in Seychelles, Mauritius, Malaysia and Hawaii, as well as in greenhouses of Belgium, France, Germany, Hungary, the Netherlands, and in the United Kingdom (Bagnall, 1909; Kesselyák, 1930; Holthuis, 1945, 1947, 1948; Gruner, 1966; Berg, 1997; Soesbergen, 2003; Kontschán, 2004; Berg *et al*., 2008; Vilisics & Hornung, 2009; Cochard *et al*., 2010; Gregory, 2009, 2014; Séchet & Noël, 2015; De Smedt *et al*., 2017, 2018). This is the first record for Switzerland.

Genus *Venezillo* Verhoeff, 1928a
Venezillo parvus (Budde-Lund, 1885)

Fig. 1D-F

Material examined: NMB; 225 males, 231 females, 60 juveniles; Switzerland, Fribourg, Kerzers, Papiliorama, Jungle Trek, 46°59’24”N, 7°12’4”E, 438 m; 19.09.2019; Gilgado and I. Bobbitt leg. – 2 males, 2 females; same data but in the collection of J.C.

Remarks: This species is native to tropical and subtropical regions, and it has been introduced in greenhouses of France, the Netherlands and in the United Kingdom (Soesbergen, 2003; Berg *et al*., 2008; Cochard *et al*., 2010; Gregory, 2009, 2014; Séchet & Noël, 2015). This is the first record for Switzerland.

Family Armadillidiidae Brandt, 1833
Genus *Armadillidium* Brandt, 1833
Armadillidium depressum Brandt, 1833

Records in Switzerland: Tessin: Lugano (Preserved specimen in Senckenberg Collection of Crustacea ZMG. GBIF occurrence 3045081082) and Locarno (Preserved specimen in Senckenberg Collection of Crustacea ZMG. GBIF occurrence 3045081140).

Remarks: This species has been only reported from France and Italy in the literature (Schmalfuss, 2003). However, the GBIF records from museum material cited above show that the species is also present in Switzerland. The species is also present in the unpublished list of the CSCF.

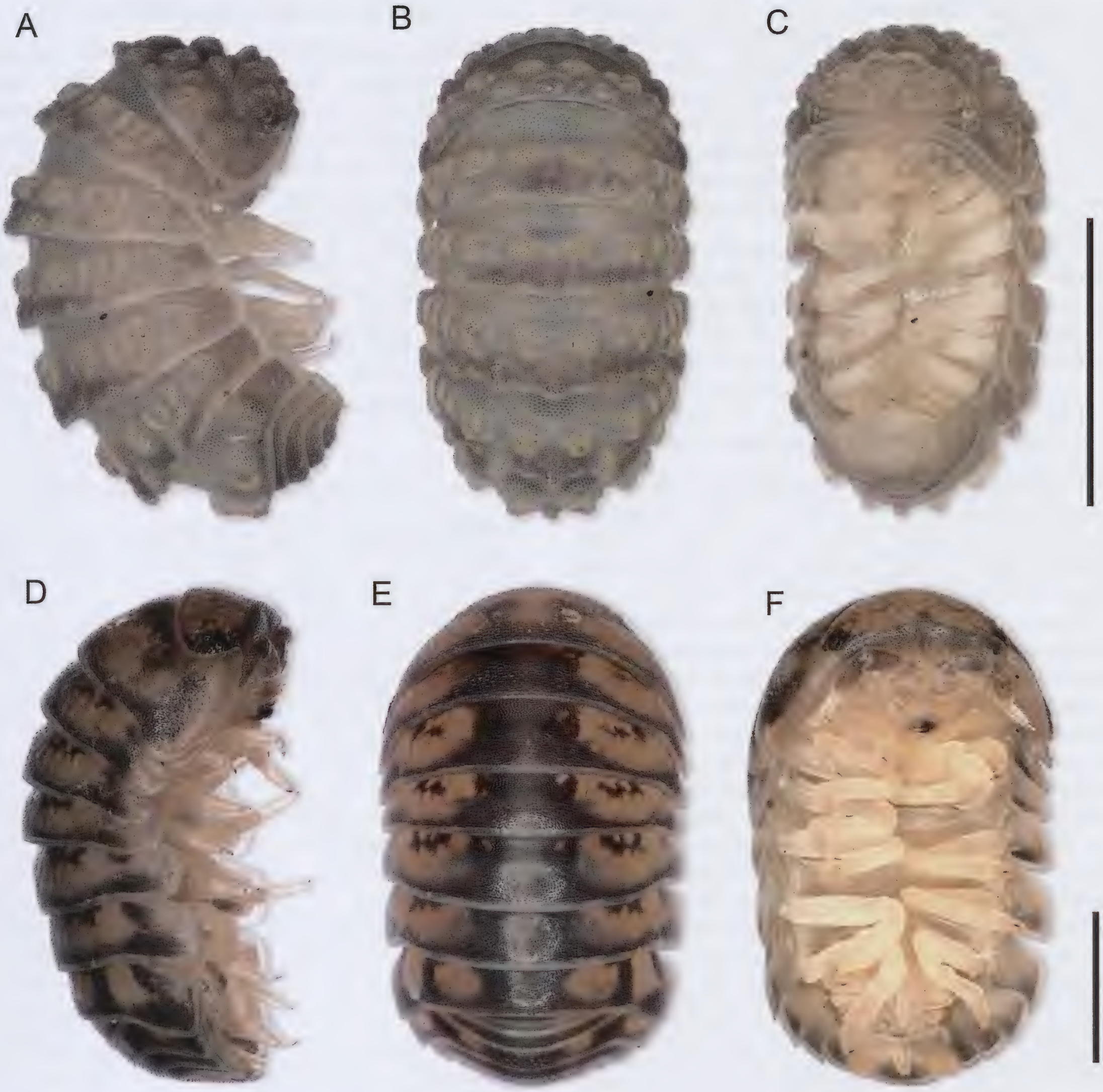


Fig. 1. Images of *Reductoniscus costulatus* in lateral (A), dorsal (B) and ventral (C) view; and *Venezillo parvus* in lateral (D), dorsal (E) and ventral (F) view. Scale bars: 1 mm.

***Armadillidium nasatum* Budde-Lund, 1885**

Material examined: NMB; 6 males, 11 females; Switzerland, Basel-Stadt, Botanical Garden of the University of Basel, Tropenhaus, 47°33'31"N, 7°34'54"E, 270 m; 20.03.2019 J.D. Gilgado and I. Bobbitt leg. – NMB; 33 males, 51 females, 1 broken; Switzerland, Bern, Botanical Garden of the University of Bern, Palmenhaus, 46°57'9"N, 7°26'44"E, 520 m; 11.12.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 13 males, 14 females; Switzerland, Geneva, Conservatory and Botanical Garden of Geneva, Serre Tropicale Principale, 46°13'31"N, 6° 8'43"E, 389 m; 22.10.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 8 males, 9 females; same data but in Jardin d'hiver. – NMB; 4 males, 6 females; Switzerland, Jura, Porrentruy, Jurassica Botanical Garden, La Grande Serre Tropicale, 47°24'48"N, 7°4'36"E; 430 m; 14.11.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 male, 1 female; Switzerland, Zurich, Botanical Garden of the University of Zurich, Tropischer Bergwald; 47°21'28.49"N, 8°33'41.14"E, 438 m; 12.12.2019; J.D. Gilgado and I. Bobbitt leg.

Bibliographical records in Switzerland: Basel-Stadt: Basel (Braschler *et al.*, 2020). **Basel-Landschaft:** Binningen, Birsfelden, Muttenz, Pratteln and

Schönenbuch (Braschler *et al.*, 2020). **Bern:** Bern (Carl, 1908a; Holzapfel, 1932). **Geneva:** Carouge and Jonction (Carl, 1908a, 1911), Onex (Carl, 1911), Satigny (Carl, 1908a, 1911). **Lucerne:** Lucerne (Vilisics *et al.*, 2012). **Solothurn:** Witterswil (Braschler *et al.*, 2020). **Tessin:** Lugano, Monte Generoso (Carl, 1908a, 1911), Lugano (Vilisics *et al.*, 2012), Maroggia-Rovio and Monte Brè (Carl, 1908a, 1911). **Zurich:** Zurich (Vilisics *et al.*, 2012).

Remarks: Species from western Europe that has been introduced in several other regions of the world (Schmalfuss, 2003). This is the first record for the canton Jura.

Armadillidium opacum (C. Koch, 1841)

Bibliographical records in Switzerland: Appenzell Inner-Rhodes: Wasserauen (Carl, 1908a). **Appenzell Outer-Rhodes:** Gais, Teufen (Carl, 1908a). **Basel-Stadt:** Basel (Carl, 1908a). **Basel-Landschaft:** Basler Jura (Carl, 1908a), Pratteln (Dollfus, 1897a), Wädenswil (Dollfus, 1892). **Bern:** Bätterkinden, Biel, Bremgarten, Emmental and Gurten (Carl, 1908a). **Geneva:** Carouge (Carl, 1908a), Geneva (Vandel, 1962). **Glarus:** Stachelberg-Braunwald (Carl, 1908a). **Grisons:** Val Bregaglia, Brienz and Churwalden (Carl, 1908a), Jenaz and Malans (Am Stein, 1857), St. Antönien valley, Thusis-Tschappins and Versam (Carl, 1908a). **Neuchâtel:** Basset, Caroline, Côte des Martels, La Crêt-du-Locle, La Chaux-de-Fonds, La Porte des Chaux, Neuchâtel, Jura mountains of Neuchâtel, Roches de Moron and Tête de Calvin (Carl, 1908a). **St. Gallen:** St. Gallen (Carl, 1908a). **Tessin:** Lugano-Carabbia and Salvatore (Carl, 1908a). **Thurgovia:** Frauenfeld (Carl, 1908a). **Vaud:** Prangins (Carl, 1908a). **Valais:** Blatten, Brig (Verhoeff, 1938), Montana, Martigny (Carl, 1908a), Naters, Stalden and Visp (Verhoeff, 1938). **Zurich:** Zurichberg (Carl, 1908a).

Remarks: This species is distributed in central and western Europe (Schmalfuss, 2003).

Armadillidium pictum Brandt, 1833

Bibliographical records in Switzerland: Basel-Stadt: Basel (Carl, 1908a). **Basel-Landschaft:** Basler Jura (Carl, 1908a). **Bern:** Biel and Bremgarten (Carl, 1908a, 1911). **Geneva:** Combe d'Envers (Carl, 1908a, 1911). **Jura**: Le Chaumont (Dollfus, 1892). **Neuchâtel:** Brenets, Caroline, Côte des Martels, Crêt-du-Locle, Halte du Creux and La Bochat (Carl, 1908a, 1911), Mail (Carl, 1911), Neuchâtel (Carl, 1908a). **Vaud:** Nyon (Carl, 1908a), Vallé de Joux (Dollfus, 1892). **Valais:** Salvan (Carl, 1911).

Remarks: This species can be found in most countries of Europe (Schmalfuss, 2003).

Armadillidium pulchellum (Zenker, 1798)

Bibliographical records in Switzerland: Appenzell Outter-Rhodes: Teufen (Carl, 1908a, 1911). **Basel-Stadt:** Basel (Carl, 1908a). **Basel-Landschaft:** Pratteln (Dollfus, 1897a). **Bern:** Bremgarten (Carl, 1908a, 1911). **Geneva:** Satigny (Carl, 1908a, 1911). **Glarus:** Schwanden (Carl, 1908a, 1911). **Grisons:** Malans (Am Stein, 1857). **Neuchâtel:** Frêtes, Halte du Creux y Mont Racine (Carl, 1908a, 1911). **St. Gallen:** St. Gallen (Carl, 1908a, 1911). **Thurgovia:** Frauenfeld (Carl, 1908a, 1911). **Vaud:** Prangins (Carl, 1908a, 1911). **Zurich:** Üetliberg (Carl, 1908a).

Remarks: This species can be found in most countries of Europe (Schmalfuss, 2003).

Armadillidium vulgare (Latreille, 1804)

Bibliographical records in Switzerland: Basel-Stadt: Basel (Dollfus, 1897b; Carl, 1908a; Braschler *et al.*, 2020). **Basel-Landschaft:** Basler Jura (Carl, 1908a), Binningen (Braschler *et al.*, 2020), Muttenz (Braschler *et al.*, 2020), Pratteln (Dollfus, 1897a; Braschler *et al.*, 2020). **Bern:** Amsoldingen, Bern, Biel and Twann (Carl, 1908a, 1911). **Geneva:** Carouge, Feuillasse, Jonction, Onex, Petit Salève, Satigny, Sionnex, Vernier and Veyrier (Carl, 1908a, 1911). **Grisons:** Chur (Am Stein, 1857), Passug and Reichenau-Trin (Carl, 1908a, 1911), Rhäzüns (Carl, 1908a). **Lucerne:** Lucerne (Vilisics *et al.*, 2012). **Neuchâtel:** Neuchâtel (Carl, 1908a, 1911). **Solothurn:** Witterswil (Braschler *et al.*, 2020). **Tessin:** Ascona (Pavesi, 1873), Biasca (Carl, 1908a), Lugano (Vilisics *et al.*, 2012), Maroggia-Rovio, Monte Brè and Salvatore (Carl, 1908a, 1911). **Thurgovia:** Frauenfeld (Carl, 1908a, 1911). **Vaud:** La Sarraz (Carl, 1908a), Prangins (Carl, 1908a, 1911), Vevey (Dollfus, 1897b). **Valais:** Martigny-Le Chemin, Niouc, Sierre, Sierre-Montana and Sitten (Carl, 1908a, 1911). **Zurich:** Zurich (Carl, 1908a; Vilisics *et al.*, 2012)

Remarks: This species is synanthropic and cosmopolitan (Schmalfuss, 2003).

Family Cylisticidae Verhoeff, 1949
Genus *Cylisticus* Schnitzler, 1853
Cylisticus biellensis Verhoeff, 1930a

Bibliographical records in Switzerland: Valais: Stalden and Visp (Verhoeff, 1938).

Remarks: This specie has only been recorded in Italy and Switzerland (Schmalfuss, 2003).

Cylisticus convexus **(De Geer, 1778)**

Material examined: NMB; 1 male, 1 female; Switzerland, Fribourg, Botanical Garden of the University of Fribourg, Forêt tropicale, 46°47'35.42"N, 7° 9'18.17"E; 631 m; 30.10.2019; J.D. Gilgado and I. Bobbitt leg.

Bibliographical records in Switzerland: Appenzell Outer-Rhodes: Gais (Carl, 1908a, 1911). **Basel-Stadt:** Basel (Carl, 1908a). **Basel-Landschaft:** Basler Jura (Carl, 1908a), Pratteln (Dollfus, 1897a). **Bern:** Bern (Carl, 1908a, 1911), Biel (Carl, 1908a, 1911). **Geneva:** Carouge, Jonction, Onex and Mont Salève (Carl, 1908a, 1911). **Glarus:** Middle of Sernf Valley (Carl, 1908a), Sernf Valley (Carl, 1911). **Grisons:** Borgonovo, Castasegna and Flims (Carl, 1908a, 1911), Jenaz (as *Porcellio laevis* Latreille, 1804 by Am Stein, 1857 according to Carl, 1908a), Küblis (Carl, 1908a, 1911), Landquart (Carl, 1911), Le Prese-Campocologno and Malans (Carl, 1908a), Passugg (Carl, 1911), Reichenau (Carl, 1908a, 1911), Rhäzüns, Schuls, Soglio and St. Antönier-Tobel (probably referring to St. Antönien Tal) (Carl, 1908a, 1911), Thusis, Trins (probably referring to Trin) (Carl, 1911), Chur (Carl, 1908a, 1911). **Lucerne:** Lucerne (Vilisics *et al*., 2012). **Neuchâtel:** Neuchâtel (Carl, 1908a, 1911). **Solothurn:** Olten (Carl, 1908a, 1911). **Tessin:** Maroggia-Rovio, Monte Brè and Muzzano (Carl, 1908a, 1911), Salvatore (Carl, 1908a). **Thurgovia:** Frauenfeld (Carl, 1908a, 1911). **Vaud:** Prangins (Carl, 1908a, 1911). **Valais:** Brig-Fiesch, Niouc and Sierre (Carl, 1908a, 1911), Sion (Carl, 1911), Sitten (Carl, 1908a). **Zurich:** Zurich-Allmend (Carl, 1911), Zurich (Carl, 1908a; Vilisics *et al*., 2012), Zurichberg (Carl, 1908a, 1911).

Remarks: This species is distributed from Spain to Anatolia, and it has been introduced in several other parts of the world (Schmalfuss, 2003). This is the first record for the Canton of Fribourg.

Family Ligiidae Brandt, 1833
Genus *Ligidium* Brandt, 1833
***Ligidium hypnorum* (Cuvier, 1792)**

Bibliographical records in Switzerland: Basel-Stadt: Basel (Carl, 1908a). **Basel-Landschaft:** Basler Jura (Carl, 1908a); Pratteln (Dollfus, 1897a). **Bern:** Bremgarten and Gurten (Carl, 1908a, 1911); Twannberg (Carl, 1911). **Geneva:** Geneva (Carl, 1911); Vernier (Carl, 1908a). **Lucerne:** Lucerne (Vilisics *et al*. 2012). **Neuchâtel:** Corgémont (Carl, 1908a, 1911); Les Moulins and Neuchâtel (Carl, 1911). **St. Gallen:** Waldtobel (Carl, 1908a, 1911). **Thurgovia:** Aumühle (Carl, 1911); Frauenfeld (Carl, 1908a, 1911); Mammern (Strouhal 1964). **Vaud:** Nyon (Carl, 1908a, 1911). **Zug:** Zug (Strouhal 1964). **Zurich:** Zurich-Allmend and Zurichberg (Carl, 1908a, 1911).

Remarks: This species is widely distributed in Switzerland. Its distribution range occupies a broad part of Europe and western Asia (Schmalfuss, 2003).

Family Oniscidae Latreille, 1802
Genus *Oniscus* Linnaeus, 1758
***Oniscus asellus* Linnaeus, 1758**

Material examined: NMB; 4 males, 6 females; Switzerland, Bern, Botanical Garden of the University of Bern, Palmenhaus, 46°57'9"N, 7°26'44"E, 520 m; 11.12.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 5 males, 12 females; Switzerland, Zurich, Botanical Garden of the University of Zurich, Tropischer Bergwald; 47°21'28.49"N, 8°33'41.14"E, 438 m; 12.12.2019; J.D. Gilgado and I. Bobbitt leg. – Collection of J.C.; 2 males, 2 females; Switzerland, Solothurn, Dornach, Scree field, 47°28'12.92"N, 7°38'32.34"E, 670 m; 24.07.2020; J.D. Gilgado leg; subterranean pitfall trap. – Collection of J.C.; 1 female; Switzerland, Laufen, Bueberg-Kaverne; 47°24'5.35"N, 7°27'43.13"E, 385 m; 06.08.2021; J.D. Gilgado leg.

Bibliographical records in Switzerland: Basel-Stadt: Basel (Carl, 1908a; Braschler *et al*., 2020). **Basel-Landschaft:** Binningen and Birsfelden (Braschler *et al*., 2020), Pratteln (Dollfus 1897a). **Bern:** Bern (Carl, 1908a; Holzapfel, 1932), Biel (Carl, 1908a). **Geneva:** Carouge and Geneva (Carl, 1908a). **Glarus:** Linthal (Carl, 1908a). **Grisons:** Malans and St. Antönien (Am Stein 1857). **Lucerne:** Lucerne (Vilisics *et al*., 2012). **Neuchâtel:** Jura mountains of Neuchâtel (Carl, 1908a). **Vaud:** Montreux (Verhoeff, 1896). **Valais:** Visp (Verhoeff, 1896) and Siders (Carl, 1908a). **Zurich:** Zurich (Vilisics *et al*., 2012).

Remarks: This species is common in western and central Europe, and it has been introduced in other regions of the world (Schmalfuss, 2003). This is the first record for the canton Solothurn.

Genus *Oroniscus* Verhoeff, 1908b
***Oroniscus helveticus* (Verhoeff, 1896)**

Bibliographical records in Switzerland: Valais: Zermat (Verhoeff, 1896, 1938).

Remarks: This species has only been cited from Switzerland.

Family Philosciidae Kinahan, 1857
Genus *Chaetophiloscia* Verhoeff, 1908b
***Chaetophiloscia cellaria* (Dollfus, 1884)**
Fig. 2C-D

Material examined: NMB; 1 male, 2 females; Switzerland, Basel-Stadt, Botanical Garden of the University of Basel, Tropenhaus, 47°33'31"N, 7°34'54"E,

270 m; 20.03.2019; J.D. Gilgado and I. Bobbitt leg. – 1 male, 2 females; same data but 03.07.2019.

Remarks: This species is found in southern Europe, from Spain to Greece (Schmalfuss, 2003). This is the first record for Switzerland.

Genus *Lepidoniscus* Verhoeff, 1908b
Lepidoniscus pruinosus (Carl, 1908)

Bibliographical records in Switzerland: Appenzell Outter-Rhodes: Gais, Teufen (Carl, 1908a, 1911). **Grisons:** Berninapass and Casaccia (Carl, 1908a), Castasegna and Col de la Bernina (Carl, 1911), Mesocco-Pian San Giacomo and Pontresina (Carl, 1908a, 1911), Promontogno-Soglio (Carl, 1911), Poschiavo (Carl, 1908a, 1911), Silvaplana-Maloja and St. Moritz (Carl, 1908a, 1911), Vicosoprano (Carl, 1908a, 1911). **St. Gallen:** St. Gallen (as *Philoscia germanica* Verhoeff, 1896 by Carl, 1911), St. Gallen (Carl, 1908a). **Tessin:** Leventina, Faido (Carl, 1908a, 1911), Sommascona (Carl, 1911), Val Blenio (Carl, 1908a, 1911).

Remarks: This species is only known from Germany, Austria, Italy and Switzerland (Schmalfuss, 2003).

Genus *Philoscia* Latreille, 1804
Philoscia muscorum (Scopoli, 1763)

Bibliographical records in Switzerland: Basel-Stadt: Basel (Braschler *et al*., 2020). **Basel-Landschaft:** Binningen, Birsfelden and Muttenz (Braschler *et al*., 2020), Pratteln (Dollfus, 1897a; Braschler *et al*., 2020). **Geneva:** Geneva (Carl, 1911). **Grisons:** Brusio (Carl, 1911), Poschiavo (Carl, 1908a, 1911). **Lucerne:** Lucerne (Vilisics *et al*., 2012). **Tessin:** Lugano-Muzzano (Carl, 1908a). **Vaud:** Lavigny and Prangins (Carl, 1911). **Zurich:** Zurich (Vilisics *et al*., 2012).

Remarks: This is a widely distributed species in Europe (Schmalfuss, 2003).

Genus *Tiroloscia* Verhoeff, 1926
Tiroloscia exigua (Budde-Lund, 1885)

Bibliographical records in Switzerland: Geneva: Geneva and Vernier (Carl, 1908a, 1911). **Vaud:** Bière (Carl, 1908a, 1911), Mont Tendre (Vandel, 1962), Prangins (Carl, 1908a, 1911; Vandel, 1962), St. Cergue (Carl, 1908a, 1911; Vandel, 1962). **Valais:** Salvan (Carl, 1911).

Remarks: This species is only known from France, Italy and Switzerland.

Family Platyarthridae Verhoeff, 1949
Genus *Platyarthrus* Brandt, 1833
Platyarthrus hoffmannseggii Brandt, 1833

Bibliographical records in Switzerland: Basel-Stadt: Basel (Carl, 1908a; Braschler *et al*., 2020). **Basel-Landschaft:** Binningen (Braschler *et al*., 2020), Pratteln (Dollfus, 1897a). **Bern:** Bern (Carl, 1908a, 1911). **Geneva:** Carouge and Geneva (Carl, 1911), Satigny (Carl, 1908a, 1911). **Grisons:** Malans (Am Stein, 1857), Promontogno-Soglio (Carl, 1908a), Thusis-Flerden (Carl, 1908a, 1911). **Lucerne:** Lucerne (Vilisics *et al*., 2012). **Neuchâtel:** Neuchâtel (Carl, 1908a, 1911). **Tessin:** Lugano (Vilisics *et al*., 2012). **Vaud:** Lavigny (Carl, 1908a, 1911). **Zurich:** Zurich (Carl, 1911; Vilisics *et al*., 2012), Zurichberg (Carl, 1908a).

Remarks: This species is found in Europe and northern Africa reaching Anatolia, and it has been introduced in North America (Schmalfuss, 2003).

Genus *Trichorhina* Budde-Lund, 1908
Trichorhina tomentosa (Budde-Lund, 1893)

Material examined: NMB; 3 females; Switzerland, Basel-Stadt, Botanical Garden of the University of Basel, Tropenhaus, 47°33'31"N, 7°34'54"E, 270 m; 27.03.2019; J.D. Gilgado and I. Bobbitt leg. – 2 females; same data but in the collection of J.C. – 2 females; same data but NMB; 03.07.2019. – NMB; 5 females; Switzerland, Basel-Stadt, Basel Zoo, Vogelhaus, 47°32'53.56"N, 7°34'43.13"E, 278 m; 10.10.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 female; Switzerland, Bern, Botanical Garden of the University of Bern, Palmenhaus, 46°57'9"N, 7°26'44"E, 520 m; 11.12.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 2 females; Switzerland, Fribourg, Kerzers, Papiliorama, Jungle Trek, 46°59'24"N, 7°12'4"E, 438 m; 19.09.2019; Gilgado and I. Bobbitt leg. – NMB; 2 females; Switzerland, Geneva, Conservatory and Botanical Garden of Geneva, Serre Tropicale Principale, 46°13'31"N, 6° 8'43"E, 389 m; 22.10.2019; J.D. Gilgado and I. Bobbitt leg. – 3 females; same data but in Jardin d'hiver. – NMB; 5 females; Switzerland, Jura, Porrentruy, Jurassica Botanical Garden, La Petite Serre Tropicale, 47°24'48"N, 7°4'36"E; 430 m; 14.11.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 female; Switzerland, St. Gallen, Botanical Garden, Tropische Nutzpflanzen, 47°26'24"N, 9°24'24"E, 662 m; 09.10.2019; J.D. Gilgado and I. Bobbitt leg.

Bibliographical records in Switzerland: Cochard *et al*. (2010) indicated the presence of this species in Switzerland, but did not provide any information on specific locations.

Remarks: This tropical American species has been introduced in greenhouses all round the world. Individuals of the species serve as food for terrarium

Fig. 2. Images of *Nagurus cristatus* in ventral (A) and dorsal (B) view; and *Chaetophiloscia cellaria* in dorsal (C) and ventral (D) view. Scale bars: 1 mm.

animals. This has also contributed to its dispersal. In Europe, the species can be found in greenhouses of many countries: Austria, Belgium, Czech Republic, Denmark, France, Germany, Hungary, Ireland, the Netherlands, Norway, Poland, United Kingdom, and Switzerland (Dollfus, 1896; Foster, 1911; Pack-Beresford & Foster, 1913; Meinertz, 1934, 1936; Holthuis, 1945, 1948, 1956; Polk, 1959; Jędryczkowski, 1979, 1981; Olsen, 1995; Berg, 1997; Wouters *et al.*, 2000; Korsós *et al.*, 2002; Soesbergen, 2003; Farkas, 2007; Berg *et al.*, 2008; Vilisics & Hornung, 2009; Cochard *et al.*, 2010; Farkas & Vilisics, 2013; Gregory, 2009, 2014; Séchet & Noël, 2015; De Smedt *et al.*, 2017, 2018; Jaskul *et al.*, 2019).

Family Porcellionidae Brandt & Ratzeburg, 1833
Genus *Porcellio* Latreille, 1804
***Porcellio alpinus* Am Stein, 1857**

Bibliographical records in Switzerland: Grisons: St. Antönien Valley (Am Stein, 1857).

Remarks: This species is only known from Switzerland, but Schmallfus (2003) considers that this is a synonym of another species of central Europe.

***Porcellio gallicus* Dollfus, 1904**

Bibliographical records in Switzerland: Geneva: Vernier (Carl, 1908a).

Remarks: This species has been recorded in Spain, France and Switzerland (Schmalfuss, 2003).

***Porcellio laevis* Latreille, 1804**

Bibliographical records in Switzerland: Valais: Niouc (Carl, 1908a), Sion (Carl, 1911) and Sitten (Carl, 1908a).

Remarks: Widely distributed in Europe and North America, it has been introduced in other regions of the world (Schmalfuss, 2003).

***Porcellio montanus* Budde-Lund, 1885**

Bibliographical records in Switzerland: Basel-Landschaft: Pratteln (Dollfus, 1897a). **Geneva:** Faucille, Geneva (Carl, 1911), Petit Salève, Pitons (Carl, 1908a, 1911). **Grisons:** Brienz, Castasegna and Flims (Carl, 1908a, 1911), Upper Engadine (Carl, 1911), Innschlucht, Malans and Maloja (Carl, 1908a), Mesocco (Carl, 1908a, 1911), Oberengadin, Pontresina y Silvaplana-Maloja (Carl, 1908a), St. Bernardino, Thusis-Flerden and Versam (Carl, 1908a, 1911). **Neuchâtel:** Neuchâtel (Carl, 1911), La Chaux-de-Fonds (Carl, 1908a), Le Locle valley (Carl, 1908a, 1911). **Tessin:** Alpe Al Sasso (Carl, 1911), Monte Generoso (Carl, 1908a), Luzzone valley (Carl, 1908a, 1911), Val Piora (Carl, 1911). **Vaud:** Nyon and St. Cergue-La Dôle (Carl, 1908a, 1911). **Valais:** Grand St. Bernard (Carl,

1908a, 1911), Sion (Carl, 1911), Sitten-Mont Tourbillon (Carl, 1908a)

Remarks: This species is known from central and eastern Europe (Schmalfuss, 2003).

Porcellio monticola Lereboullet, 1853

Bibliographical records in Switzerland: Basel-Stadt: Basel (Carl, 1908a). **Basel-Landschaft:** Pratteln (Dollfus 1897a).

Remarks: This species is known from Spain, France and Germany, and Schmalfuss (2003) suggests that the records in Switzerland and Italy may correspond to different species. In the absence of recent verified data, we do not include this taxon in the list of species from Switzerland.

Porcellio pumicatus Budde-Lund, 1885

Records in Switzerland: Geneva: Geneva (Preserved specimen in Natural History Museum of London. GBIF occurrence 1055565715).

Remarks: This species occurs in Central Italy and Sardinia (Schmalfuss, 2003). The record from Geneva is far away from its known distribution, and there are no other verified records. Therefore, this record is doubtful and should not be included in the checklist.

Porcellio scaber Latreille, 1804

Material examined: NMB; 1 female; Switzerland, Basel-Stadt, Botanical Garden of the University of Basel, Tropenhaus, 47°33'31"N, 7°34'54"E, 270 m; 03.07.2019; J.D. Gilgado and I. Bobbitt leg. – 1 female; same data but 20.03.2019. – NMB; 1 male, 5 females; Switzerland, Bern, Botanical Garden of the University of Bern, Palmenhaus, 46°57'9"N, 7°26'44"E, 520 m; 11.12.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 male, 2 females; Switzerland, Fribourg, Botanical Garden of the University of Fribourg, Plantes utiles tropicales, 46°47'35"N, 7° 9'18"E; 631 m; 30.10.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 male, 3 females; Switzerland, St. Gallen, Botanical Garden, Compost heap (outdoors), 47°26'28.20"N, 9°24'25.35"E, 670 m; 09.10.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 male, 1 female; Switzerland, Zurich, Botanical Garden of the University of Zurich, Tropischer Bergwald; 47°21'28.49"N, 8°33'41.14"E, 438 m; 12.12.2019; J.D. Gilgado and I. Bobbitt leg.

Bibliographical records in Switzerland: Appenzell Outer-Rhodes: Gais (Carl, 1908a). **Basel-Stadt:** Basel (Carl, 1908a; Braschler *et al.*, 2020). **Basel-Landschaft:** Binningen, Birsfelden and Schönenbuch (Braschler *et al.*, 2020), Pratteln (Dollfus, 1897a; Braschler *et al.*, 2020). **Bern:** Bern (Carl, 1908a; Holzapfel, 1932). **Glarus:** Schwanden-Elm (Carl, 1908a). **Grisons:** Chur and Passugg (Carl, 1908a), Jenaz (Am Stein, 1857), Malans (Am Stein, 1857), Poschiavo (Carl, 1908a), Schuls (Carl, 1908a), St. Antönien valley (Am Stein, 1857), Versam (Carl, 1908a), Vicosoprano (Carl, 1908a). **Lucerne:** Lucerne (Vilisics *et al.*, 2012). **Solothurn:** Witterswil (Braschler *et al.*, 2020). **St. Gallen:** St. Gallen (Carl, 1908a). **Tessin:** Airolo (Dollfus, 1897b), Airolo-Val Piora (Carl, 1908a), Ascona (Pavesi, 1873), Lugano (Vilisics *et al.*, 2012), Val Blenio (Carl, 1908a). **Vaud:** Lausanne, Lavigny-Aubonne and Nyon (Carl, 1908a). **Valais:** Brig (Verhoeff, 1938), Montana (Carl, 1908a), Naters (Verhoeff, 1938), Niouc and Salvan (Carl, 1908a), Stalden and Zermatt (Verhoeff, 1938), Sitten (Carl, 1908a), no precise location (Dollfus, 1897b). **Zurich:** Zurich (Vilisics *et al.*, 2012)

Remarks: This species is native to western Europe, and it has been introduced in other regions of the world (Schmalfuss, 2003). This is the first record for the canton of Fribourg.

Porcellio spinicornis Say, 1818

Bibliographical records in Switzerland: Basel-Stadt: Basel (Carl, 1908a). **Basel-Landschaft:** Basler Jura (Carl, 1908a), Pratteln (Dollfus, 1897a). **Bern:** Bern (Carl, 1908a), Emmental (Carl, 1911), Middle Emmental (Carl, 1908a), Twann (Carl, 1911). **Geneva:** Collonge, Geneva, Petit Salève and Satigny (Carl, 1908a, 1911). **Glarus:** Linthal (Carl, 1911), Schwanden (Carl, 1908a, 1911), Stachelberg (Carl, 1911). **Grisons:** Casaccia-Vicosoprano (Carl, 1911), Küblis and Landquart (Carl, 1908a, 1911), Malans (Am Stein, 1857), Schuls (Carl, 1908a). **Neuchâtel:** La Chaux-de-Fonds (Carl, 1908a, 1911), Locle (Carl, 1911), Neuchâtel (Carl, 1908a, 1911), valleys of Locle (Carl, 1908a). **Solothurn:** Bätterkinden und Olten (Carl, 1911). **Tessin:** Airolo-Val Piora (Carl, 1908a), Ascona (Pavesi, 1873). **Thurgovia:** Frauenfeld (Carl, 1908a, 1911). **Vaud:** Duillier (Carl, 1911), Lavigny and Prangins (Carl, 1908a, 1911). **Valais:** Brig and Fiesch (Verhoeff, 1938), Montana (Carl, 1911), Niouc (Carl, 1908a, 1911), Sierre and Sion (Carl, 1911), Stalden (Verhoeff, 1938), Dranse valley (Carl, 1911), Sitten (Carl, 1908a). **Zurich:** Zurichberg (Carl, 1908a, 1911).

Remarks: This species is native to western and central Europe and it has been introduced in other parts of the world (Schmalfuss, 2003).

Porcellio sylvestris **Fabr.**

Bibliographical records in Switzerland: Tessin: Ascona (Pavesi, 1873).

Remarks: This is a dubious taxon (see discussion). Pavesi (1873) cites the species from Tessin as *Porcellio sylvestris* Fabr., with no year. However, it cannot be adscribed to any known species.

Genus *Porcellionides* Miers, 1877
***Porcellionides pruinosus* (Brandt, 1833)**

Material examined: NMB; 8 males, 5 females; Switzerland, Fribourg, Kerzers, Papiliorama, Jungle Trek, 46°59'24"N, 7°12'4"E, 438 m; 19.09.2019; Gilgado and I. Bobbitt leg. – NMB; 3 males, 1 female; Switzerland, Geneva, Conservatory and Botanical Garden of Geneva, Compost heap (outdoors), 46°13'42.10"N, 6° 8'54.94"E, 380 m; 22.10.2019; J.D. Gilgado and I. Bobbitt leg. – 1 female; same data but in Jardin d'hiver.

Bibliographical records in Switzerland: Basel-Stadt: Basel (Dollfus, 1897b; Carl, 1908a, 1911). **Basel-Landschaft:** Pratteln (Dollfus, 1897a). **Bern:** Bern (Carl, 1908a, 1911). **Geneva:** Carouge (Carl, 1908a, 1911), Creux de Genthod (Carl, 1908a), Genthod (Carl, 1911), Onex, Petit Salève, Satigny and Vernier (Carl, 1908a, 1911). **Grisons:** Schuls (Carl, 1908a, 1911). **Neuchâtel:** Jura mountains of Neuchâtel (Carl, 1908a). **Tessin:** Maroggia-Rovio (Carl, 1908a). **Vaud:** Lausanne, Lavigny-Aubonne and Nyon (Carl, 1908a, 1911). **Valais:** Sierre-Loc (Carl, 1908a, 1911), Visp (Verhoeff, 1938). **Zurich:** Zurich (Vilisics *et al*., 2012), Zurichberg (Carl, 1908a, 1911).

Remarks: Species of mediterranean origin. It has been introduced in other regions of the world (Schmalfuss, 2003). This is the first record for the canton of Fribourg.

Family Trachelipodidae Strouhal, 1953
Genus *Nagurus* Holthuis, 1949
***Nagurus cristatus* (Dollfus, 1889)**
Fig. 2A-B

Material examined: NMB; 1 female; Switzerland, Bern, Botanical Garden of the University of Bern, Palmenhaus, 46°57'9"N, 7°26'44"E, 520 m; 11.12.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 2 females; Switzerland, Fribourg, Botanical Garden of the University of Fribourg, Forêt tropicale, 46°47'35.42"N, 7° 9'18.17"E; 631 m; 30.10.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 6 females, 1 immature; Switzerland, Fribourg, Kerzers, Papiliorama, Jungle Trek, 46°59'24"N, 7°12'4"E, 438 m; 19.09.2019; Gilgado and I. Bobbitt leg. – 2 females; same data but in the collection of J.C. – NMB; 5 females; Switzerland, Zurich, Botanical Garden of the University of Zurich, Tropischer Tieflandregenwald, 47°21'28"N, 8°33'42"E, 438 m; 12.12.2019; J.D. Gilgado and I. Bobbitt leg.

Remarks: This is a synanthopic pantropical species that can also be found in greenhouses. It has been recorded in Europe in Belgium, France, Germany, the Netherlands, Romania and in the United Kingdom (Holthuis, 1945, 1949, 1956; Berg, 1997; Soesbergen, 2003; Berg *et al*., 2008; Cochard *et al*., 2010; Gregory, 2009, 2014; Giurginca *et al*., 2015; Séchet & Noël, 2015; De Smedt *et al*., 2017, 2018). This is the first record for Switzerland.

Genus *Porcellium* Dahl, 1916
***Porcellium conspersum* (C. Koch, 1841)**

Bibliographical records in Switzerland: Basel-Stadt: Basel (Carl, 1908a, 1911). **Basel-Landschaft:** Basler Jura (Carl, 1908a, 1911). **Bern:** Interlaken and Twannberg (Carl, 1908a, 1911). **Grisons:** Filisur (Carl, 1908a). **Thurgovia:** Frauenfeld (Carl, 1908a, 1911), Mammern (Strouhal, 1964). **Zug:** Zug (Strouhal, 1964). **Zurich:** Zurichberg (Carl, 1908a, 1911).

Remarks: This species can be found in most of Europe (Schmalfuss, 2003).

Genus *Trachelipus* Budde-Lund, 1908
***Trachelipus arcuatus* (Budde-Lund, 1885)**

Bibliographical records in Switzerland: Grisons: Val Bregaglia (Carl, 1908a), Castasegna (Carl, 1908a), Upper-Engadine (Carl, 1911), Maloja (Carl, 1908a, 1911), Misox Valley, Upper Engadin, Pontresina and Silvaplana (Carl, 1908a), Promontogno, Poschiavo y Val Calanca (Carl, 1908a, 1911), Mesocco Valley - San Bernardino (Carl, 1911). **Tessin:** Carabbia (Carl, 1911), Carabbia, Monte Generoso (Carl, 1908a), Lugano, Mendrisio, Monte Brè, Muzzano y Rovio (Carl, 1908a, 1911), Blenio Valley (Carl, 1908a), Val Leventina (Carl, 1908a).

Remarks: This species is known from several countries from central and mediterranean Europe (Schmalfuss, 2003).

***Trachelipus rathkii* (Brandt, 1833)**

Material examined: NMB; 1 male, 1 female; Switzerland, St. Gallen, Botanical Garden, Compost heap (outdoors), 47°26'28.20"N, 9°24'25.35"E, 670 m; 09.10.2019; J.D. Gilgado and I. Bobbitt leg. – 1 male, 1 female; same data but in the collection of J.C.

Bibliographical records in Switzerland: Appenzell Outer-Rhodes: Gais, Teufen (Carl, 1908a). **Basel-Stadt:** Basel (Carl, 1908a; Braschler *et al*., 2020). **Basel-Landschaft:** Binningen, Birsfelden and

Schönenbuch (Braschler *et al*., 2020), Pratteln (Dollfus, 1897a; Braschler *et al*., 2020). **Bern:** Bätterkinden (Carl, 1908a), Bern (Carl, 1908a; Holzapfel, 1932), basis of Gurten (Carl, 1911). **Geneva:** Creux de Genthod (Carl, 1908a, 1911). **Glarus:** Schwanden (Carl, 1908a). **Grisons:** Malans (Am Stein, 1857). **Lucerne:** Lucerne (Vilisics *et al*., 2012). **Solothurn:** Bätterkinden (Carl, 1911), Olten (Carl, 1908a, 1911). **St. Gallen:** St. Gallen (Carl, 1908a). **Tessin:** Airolo-Val Piora (Carl, 1908a), Carabbia (Carl, 1911), Carabbia Monte Generoso (Hollier 2018), Carabbia Monte Salvatore (Carl, 1908a), Lugano (Vilisics *et al*., 2012), Maroggia-Rovio (Carl, 1908a, 1911; Hollier, 2018), Monte Brè (Carl, 1908a; Hollier, 2018), Muzzano (Carl, 1908a, 1911; Hollier 2018). **Thurgovia:** Frauenfeld and Müllheim (Carl, 1908a, 1911). **Vaud:** Lausanne, Lavigny and Nyon (Carl, 1908a, 1911). **Valais:** Naters (Verhoeff, 1938). **Zurich:** Zurich (Carl, 1908a; Vilisics *et al*., 2012), Zurich-Allmend (Carl, 1911), Zurichberg (Carl, 1908a, 1911).

Remark: This species is known from central and eastern Europe (Schmalfuss, 2003).

Trachelipus ratzeburgii (Brandt, 1833)

Material examined: BNM; 2 males, 1 female; Switzerland, Grisons, S-chanf, Val Trupchun, 46°36'25.53"N, 10° 2'21.96"E, 1800 m; 14.08.2018; J.D. Gilgado leg. – 25 males, 62 females, 29 juveniles; same data but 46°36'20.57"N, 10° 3'22.58"E, 1900 m. – 20 males, 27 females; same data but Val Müschauns, 46°36'34.66"N, 10°3'40.89"E, 2000 m. – 2 males, 2 females, same data but in the collection of J.C. – 3 males, 16 females; same data but 46°36'43.59"N, 10° 3'52.13"E, 2050 m.

Bibliographical records in Switzerland: Appenzell Inner-Rhodes: Säntis (Carl, 1911), Säntis region (Carl, 1908a). **Appenzell Outer-Rhodes:** Gais, Teufen (Carl, 1908a, 1911). **Basel-Stadt:** Basel (Carl, 1911). **Basel-Landschaft:** Basler Jura (Carl, 1911), Pratteln (Dollfus, 1897a; Carl, 1911). **Bern:** Bern (Carl, 1908a), Stachelberg (Carl, 1908a). **Glarus:** Plateau of Braunwald and Bläggialp (location not found), Linthal and Schwanden (Carl, 1908a, 1911), **Grisons:** Lower-Engadine (Carl, 1911), Val Bregaglia (Carl, 1908a), Bergün, Casaccia-Promontogno, Churwalden, Chur, Upper-Engadine and Heinzenberg (Carl, 1911), Jenaz (Am Stein, 1857; Carl, 1911), Maienfeld (Am Stein, 1857; Carl, 1911), Malans (Am Stein, 1857; Carl, 1911), Malanser and Ochsenalp (Carl, 1911), Pontresina and Schuls (Carl, 1908a), St. Antönien Valley (Am Stein, 1857; Carl, 1908a, 1911), Lower Engadin (Carl, 1908a), Stuls Valley (Carl, 1911), Versam (Carl, 1908a). **St. Gallen:** St. Gallen (Carl, 1911), St. Gallen (Carl, 1908a, 1911). **Tessin:** Alp Al Sasso and Val Luzzone (Carl, 1908a, 1911), Val Piora (Carl, 1908a). **Thurgovia:** Mammern (Strouhal, 1964). **Vaud:** St. Cergue (Carl, 1908a, 1911). **Zurich:** Zurich (Carl, 1908a, 1911).

Remarks: This species is known from eastern and central Europe (Schmalfuss, 2003).

Trachelipus razzautii (Arcangeli, 1913)

Bibliographical records in Switzerland: Tessin: Lugano (Vilisics *et al*., 2012)

Remarks: It is known from several countries of central and mediterranean Europe (Schmalfuss, 2003).

Family Trichoniscidae Sars, 1898
Genus *Androniscus* Verhoeff, 1908a
Androniscus dentiger Verhoeff, 1908a

Material examined: NMB; 7 males, 7 females; Switzerland, Fribourg, Botanical Garden of the University of Fribourg, Forêt tropicale, 46°47'35.42"N, 7°9'18.17"E; 631 m; 30.10.2019; J.D. Gilgado and I. Bobbitt leg. – 1 male; same data but Plantes utiles tropicales. – Collection of J.C.; 1 male, 3 females; Switzerland, Laufen, Bueberg-Kaverne; 47°24'5.35"N, 7°27'43.13"E, 385 m; 06.08.2021; J.D. Gilgado leg.

Bibliographical records in Switzerland: Bern: Bern (Holzapfel, 1932). **Geneva:** Jonction (as *A. alpinus* Verhoeff, 1908a by Carl, 1911). **Lucerne:** Lucerne (Vilisics *et al*., 2012). **Tessin:** Lugano, Monte Generoso (as *A.* a*lpinus*) by Verhoeff (1908a); Rovio and Monte Bré (as *A. subterraneus* Carl, 1906) by Carl (1908a, 1911). **Zurich:** Zurich (Vilisics *et al*., 2012).

Remarks: This species can be found in Europe and northern Africa, but it has also been reported in greenhouses of North America (Schmalfuss, 2003). This is the first records of the species in Fribourg.

Androniscus roseus (C. Koch, 1838)

Bibliographical records in Switzerland: Appenzell Outter-Rhodes: Gais, Teufen (Carl, 1908a, 1911). **Appenzell Inner-Rhodes:** Appenzell (Vandel, 1960). **Geneva:** Geneva (Carl, 1908a), Jonction (Carl, 1908a). **Grisons:** Malans (Am Stein, 1857). **St. Gallen:** St. Gallen (Carl, 1908a, 1911). **Thurgovia:** Frauenfeld (Carl, 1908a, 1911).

Remarks: This species has been recorded from southern France to Romania (Schmalfuss, 2003).

Androniscus subterraneus (Carl, 1906)

Bibliographical records in Switzerland: Tessin: Lugano (Grotte de Val Tazzino; Grotte von Osteno),

Monte Generoso (Grotte de Tre Buchi; Grotte dell'Alabastro), all by Carl (1906, 1908a, 1911). Mendrisio (Grotte del Mago, Carl, 1906, 1908a, 1911; Grotte Tanone, Carl, 1908a). Rovio and Monté Bré (Carl, 1908a).

Remarks: This species is only known from some caves in Italy and Switzerland (Schmalfuss, 2003).

Genus *Buddelundiella* Silvestri, 1897
Buddelundiella cataractae Verhoeff, 1930b

Fig. 3A-C

Material examined: NMB; 10 females, 98 broken; Switzerland, Bern, Botanical Garden of the University of Bern, Palmenhaus, 46°57'9"N, 7°26'44"E, 520 m; 11.12.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 female, 1 broken; Switzerland, Fribourg, Botanical Garden of the University of Fribourg, Forêt tropicale, 46°47'35.42"N, 7° 9'18.17"E; 631 m; 30.10.2019; J.D. Gilgado and I. Bobbitt leg. – 2 females; same data but Plantes utiles tropicales. – NMB; 5 females, 1 broken, 1 juvenile; Switzerland, Geneva, Conservatory and Botanical Garden of Geneva, Serre Tropicale Principale, 46°13'31"N, 6° 8'43"E, 389 m; 22.10.2019; J.D. Gilgado and I. Bobbitt leg. – 2 females; same data but in the collection of J.C. – NMB; 1 male; Switzerland, St. Gallen, Botanical Garden, Tropische Nutzpflanzen, 47°26'24"N, 9°24'24"E, 662 m; 09.10.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 5 females; Switzerland, Zurich, Botanical Garden of the University of Zurich, Tropischer Tieflandregenwald, 47°21'28"N, 8°33'42"E, 438 m; 12.12.2019; J.D. Gilgado and I. Bobbitt leg. – 8 females, same data but Tropischer Bergwald.

Remarks: This is a synanthropic species (Schmalfuss, 2003). Despite being common in Europe, this is its first record in Switzerland.

Genus *Calconiscellus* Verhoeff, 1927a
Calconiscellus gibbosus (Carl, 1908a)

Bibliographical records in Switzerland: Tessin: Monte Generoso, Grotta del Tanone (Carl, 1908a), Grotta Tre Buchi (Carl, 1908a, 1911).

Remarks: This species is only known from a couple of caves in Switzerland.

Genus *Carloniscus* Verhoeff, 1936
Carloniscus dollfusi (Carl, 1908b)

Bibliographical records in Switzerland: None, but Schmalfuss (2003) assumes that the species occurs in the Swiss Alps.

Remarks: According to Schmalfuss (2003), this species inhabits the Alps (France and Switzerland) and Corsica. Nevertheless, no records of the species in Switzerland could be found. Therefore, its presence in Switzerland is not confirmed and should be consider to inhabit the French Alps and Corsica, as indicated by Taiti & Ferrara (1996).

Genus *Haplophthalmus* Schöbl, 1860
Haplophthalmus danicus Budde-Lund, 1880

Material examined: NMB; 1 female; Switzerland, Basel-Stadt, Botanical Garden of the University of Basel, Tropenhaus, 47°33'31"N, 7°34'54"E, 270 m; 27.03.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 female; Switzerland, Fribourg, Kerzers, Papiliorama, Jungle Trek, 46°59'24"N, 7°12'4"E, 438 m; 19.09.2019; Gilgado and I. Bobbitt leg. – NMB; 11 males, 15 females; Switzerland, Geneva, Conservatory and Botanical Garden of Geneva, Serre Tropicale Principale, 46°13'31"N, 6° 8'43"E, 389 m; 22.10.2019; J.D. Gilgado and I. Bobbitt leg. – 2 females; same data but Jardin d'hiver. – NMB; 2 males, 2 females; Switzerland, St. Gallen, Botanical Garden, Tropische Nutzpflanzen, 47°26'24"N, 9°24'24"E, 662 m; 09.10.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 female; Switzerland, Zurich, Botanical Garden of the University of Zurich, Tropischer Tieflandregenwald, 47°21'28"N, 8°33'42"E, 438 m; 12.12.2019; J.D. Gilgado and I. Bobbitt leg. – 1 male, 3 females; same data but Tropischer Bergwald.

Bibliographical records in Switzerland: Basel-Landschaft: Binningen (Braschler *et al.*, 2020), Pratteln (Dollfus, 1897a). **Bern:** Bern (Carl, 1908a; Holzapfel, 1932). **Geneva:** Creux de Genthod (Carl, 1908a, 1911), Satigny (Carl, 1908a). **Solothurn:** Witterswil (Braschler *et al.*, 2020). **Tessin:** Lugano (Vilisics *et al.*, 2012). **Thurgovia:** Frauenfeld (Carl, 1908a).

Remarks: This species is native in Europe, but has also been introduced in other parts of the world (Schmalfuss, 2003). These are the first records for the cantons of Fribourg, St. Gallen and Zurich.

Haplophthalmus mengii (Zaddach, 1844)

Material examined: NMB; 1 male; Switzerland, Fribourg, Botanical Garden of the University of Fribourg, Plantes utiles tropicales, 46°47'35"N, 7° 9'18"E; 631 m; 30.10.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 male, 2 females; Switzerland, Zurich, Botanical Garden of the University of Zurich, Tropischer Bergwald; 47°21'28.49"N, 8°33'41.14"E, 438 m; 12.12.2019; J.D. Gilgado and I. Bobbitt leg. – Collection of J.C.; 1 female; Switzerland, Laufen, Bueberg-Kaverne; 47°24'5.35"N, 7°27'43.13"E, 385 m; 06.08.2021; J.D. Gilgado leg.

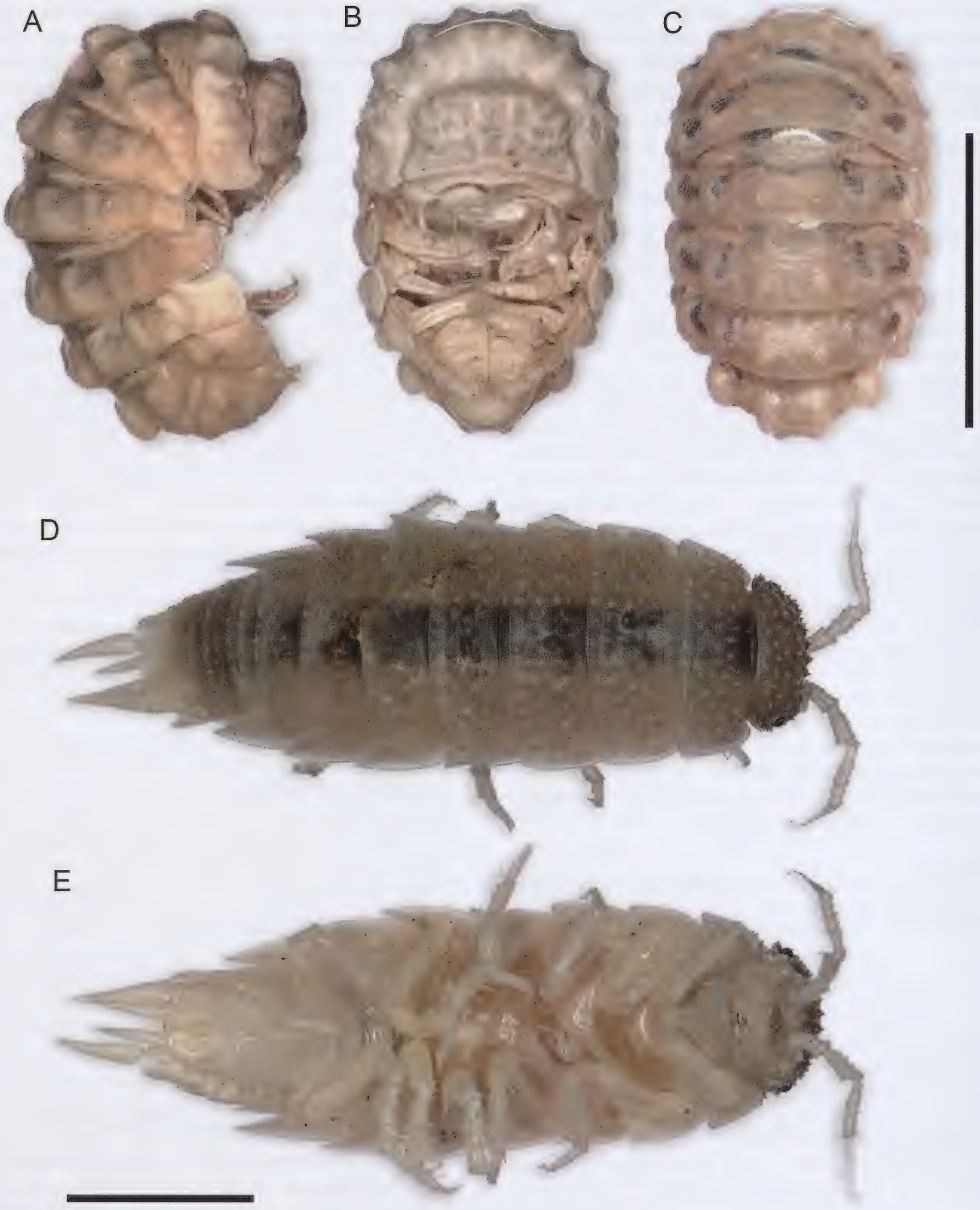


Fig. 3. Images of *Buddelundiella cataractae* in lateral (A), ventral (B) and dorsal (C) view; and *Miktoniscus linearis* in dorsal (D) and ventral (E) view. Scale bars: 1 mm.

Bibliographical records in Switzerland: Basel-Landschaft: Pratteln (Dollfus, 1897a). **Bern:** Bern (Carl, 1908a; Holzapfel, 1932). **Geneva:** Geneva (Carl, 1908a, 1911). **Thurgovia:** Frauenfeld (Carl, 1908a, 1911). **Zurich:** Zurich (Carl, 1908a), Zurichberg (Carl, 1908a, 1911).

Remarks: This species can be found in Europe, northern Africa, Azores and the Canary Islands (Schmalfuss, 2003). This is the first record for the canton of Fribourg.

Haplophthalmus montivagus Verhoeff, 1941

Bibliographical records in Switzerland: Thurgovia: Mammern (Strouhal, 1964). **Zug:** Zug (Strouhal, 1964).

Remarks: This species is common in Europe (Schmalfuss, 2003). Vandel (1960) considered it as a synonym of *H. mengii*, but Schmalfuss (2003) stated that it is a valid species.

Haplophthalmus perezi Legrand, 1942

Bibliographical records in Switzerland: Switzerland, no precise locality given (Vandel, 1960)

Remarks: According to Schmalfuss (2003) it is a synonym of *H. mengii*.

Genus *Hyloniscus* Verhoeff, 1908d
Hyloniscus riparius (C. Koch, 1838)

Material examined: NMB; 1 female; Switzerland, Basel-Stadt, Botanical Garden of the University of Basel, Tropenhaus, 47°33'31"N, 7°34'54"E, 270 m; 27.03.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 female; Switzerland, Bern, Botanical Garden of the University of Bern, Palmenhaus, 46°57'9"N, 7°26'44"E, 520 m; 11.12.2019; J.D. Gilgado and I. Bobbitt leg. – NMB; 1 female; Switzerland, Fribourg, Botanical Garden of the University of Fribourg, Forêt tropicale, 46°47'35.42"N, 7° 9'18.17"E; 631 m; 30.10.2019; J.D. Gilgado and I. Bobbitt leg. – 1 males; same data but Plantes utiles tropicales. – 1 male, 1 female; same data but in the collection of J.C. – NMB; 1 male, 2 females; Switzerland, Geneva, Conservatory and Botanical Garden of Geneva, Serre Tropicale Principale, 46°13'31"N, 6° 8'43"E, 389 m; 22.10.2019; J.D. Gilgado and I. Bobbitt leg.

Bibliographical records in Switzerland: Appenzell Outer-Rhodes: Gais, Teufen (Carl, 1908a, 1911). **Basel-Stadt:** Basel (Braschler *et al.*, 2020). **Basel-Landschaft:** Binningen, Birsfelden, Muttenz and Pratteln (Braschler *et al.*, 2020). **Bern:** Bern (Carl, 1908a, 1911; Holzapfel, 1932). **Geneva:** Geneva (Carl, 1908a, 1911). **Lucerne:** Lucerne (Vilisics *et al.*, 2012). **Solothurn:** Witterswil (Braschler *et al.*, 2020). **St. Gallen:** St. Gallen (Carl, 1908a, 1911). **Tessin:** Lugano (Vilisics *et al.*, 2012). **Thurgovia:** Frauenfeld (Carl, 1908a, 1911). **Zug:** Zug (Strouhal, 1964). **Zurich:** Zurich (Carl, 1908a, 1911; Vilisics *et al.*, 2012), Zurichberg (Carl, 1908a, 1911).

Remarks: This species can be found in east and central Europe, and it has been introduced in North America (Schmalfuss, 2003). This is the first record for the canton Fribourg.

Genus *Leucocyphoniscus* Verhoeff, 1900
Leucocyphoniscus verruciger Verhoeff, 1900

Bibliographical records in Switzerland: Tessin: Meride, Grotte La Böggia (Carl, 1908a), Monte Generoso, Grotta dell'Alabastro (Carl, 1906, 1908a, 1911), Monte Generoso (Verhoeff, 1900).

Remarks: This species is only known from Italy and Switzerland (Schmalfuss, 2003).

Genus *Miktoniscus* Kesselyák, 1930
Miktoniscus linearis (Patience, 1908)

Fig. 3D-E

Material examined: NMB; 1 male, 4 females; Switzerland, Fribourg, Kerzers, Papiliorama, Jungle Trek, 46°59'24"N, 7°12'4"E, 438 m; 19.09.2019; Gilgado and I. Bobbitt leg. – NMB; 4 males, 12 females ; Switzerland, Geneva, Conservatory and Botanical Garden of Geneva, Serre Tropicale Principale, 46°13'31"N, 6°8'43"E, 389 m; 22.10.2019; J.D. Gilgado and I. Bobbitt leg. – 2 males, 1 female; same data but in the collection of J.C. – 4 males, 3 females; same data but NMB; Jardin d'hiver.

Remarks: This species was hitherto only known from greenhouses in the United Kingdom and Germany (Patience, 1908; Gruner, 1966; Gregory, 2009). This is the first record for Switzerland.

Genus *Trichoniscoides* Sars, 1898
Trichoniscoides helveticus (Carl, 1908a)

Bibliographical records in Switzerland: Geneva: Jonction (Carl, 1908a, 1911). **Neuchâtel:** Crêt-du-Locle (Carl, 1908a, 1911). **Thurgovia:** Frauenfeld (Carl, 1908a, 1911). **Zurich:** Zürichberg (Carl, 1908a).

Remarks: This species is natively distributed in central and northern Europe (Schmalfuss, 2003).

Trichoniscoides pulchellus **Legrand, 1950**

Bibliographical records in Switzerland: Valais: Saint Maurice (Vandel, 1960).

Remarks: This species has only been recorded in Switzerland and France (Schmalfuss, 2003).

Genus *Trichoniscus* Brandt, 1833

Trichoniscus alemannicus **Verhoeff, 1917c**

Bibliographical records in Switzerland: Lucerne: Lucerne (Vilisics *et al*., 2012). **Nidwalden:** Hergiswil (albeit doubtful according to Vandel (1960)]. **Thurgovia:** Mammern (Strouhal, 1964). **Zug:** Zug (Strouhal, 1964). **Zurich:** Zurich (Vilisics *et al*., 2012).

Remarks: This species is native to central and western Europe (Schmalfuss, 2003).

Trichoniscus circuliger **Verhoeff, 1931**

Bibliographical records in Switzerland: Grisons: Poschiavo (Verhoeff, 1931).

Remarks: This species has only been recorded in Italy and Switzerland (Verhoeff, 1931).

Trichoniscus noricus **Verhoeff, 1917b**

Bibliographical records in Switzerland: Zug: Zug (Strouhal, 1964).

Remarks: This species in only known from central and eastern Europe (Schmalfuss, 2003).

Trichoniscus provisorius **Racovitza, 1908**

Bibliographical records in Switzerland: Without locality (Vandel, 1960).

Remarks: This is a common species in Europe and northern Africa, and it has been introduced in other regions of the world (Schmalfuss, 2003).

Trichoniscus pusillus **Brandt, 1833**

Bibliographical records in Switzerland: Appenzell Outter-Rhodes: Gais, Teufen (Carl, 1908a). **Basel-Landschaft:** Pratteln (Dollfus 1897a). **Bern:** Bern (Carl, 1908a), Gurten (Carl, 1908a). **Geneva:** Carouge, Combe d'Envers, Creux de Genthod, Jonction, Satigny and Vandoeuvres (Carl, 1908a). **Glarus:** Glarus, Braunwald Plateau and Schwanden (Carl, 1908a). **Grisons:** Flims, Le Prese, Mesocco, Reichenau-Trins (probably referring to Trin), St. Antöniertobel (probably referring to St. Antönier valley) and Vicosoprano-Castasegna (Carl, 1908a). **Lucerne:** Lucerne (Vilisics *et al*., 2012). **Neuchâtel:** Chaux-de-Fonts, Le Locle and Moulins (Carl, 1908a). **St. Gallen:** St. Gallen (Carl, 1908a). **Thurgovia:** Frauenfeld (Carl, 1908a). **Tessin:** Monte Bré (Carl, 1908a). **Vaud:** Lausanne and St. Cergues-Dôle (Carl, 1908a). **Valais:** Glarey, Montana, Sierre and Wald. (Carl, 1908a). **Zurich:** Zurich-Allmend and Zürichberg (Carl, 1908a).

Remarks: A common species in Europe, which has been introduced in other regions of the world (Schmalfuss 2003).

Trichoniscus pygmaeus **Sars, 1898**

Bibliographical records in Switzerland: Bern: Bern (Carl, 1908a, 1911; Holzapfel, 1932). **Geneva:** Jonction (Carl, 1908a, 1911). **Zurich:** Zurichberg (Carl, 1908a, 1911).

Remarks: A common species in Europe and northern Africa, it has been introduced in other regions of the world (Schmalfuss, 2003).

DISCUSSION

The checklist of woodlice in Switzerland

Before the present work, 51 woodlice species had been recorded in Switzerland. However, six of them are dubious and should not be on the list (Table 3). Those species are: 1) *Carloniscus dollfusi* (Carl, 1908b). Its presence in Switzerland is possible. However, as indicated by Schmalfuss (2003), the existing records correspond to Corsica and the Departments of Isère and Drôme in France (Carl, 1908a; Vandel, 1960; Taiti & Ferrara, 1996). 2) *Haplophthalmus perezi* Legrand, 1942. Schmalfuss (2003) questioned the validity of this record by Vandel (1960), considering it as a synonym of *H. mengii* (Zaddach, 1844). 3) *Porcellio alpinus* Am Stein, 1857. The validity of this species is dubious, as the description made by the author is not detailed enough to distiguish it from other species. 4) *Porcellio monticola* Lereboullet, 1853. This species has been recorded in Switzerland by Dollfus (1897a) and Carl (1908a). However, Schmalfuss (2003) considered that these records may correspond to other species. 5) *Porcellio pumicatus* Budde-Lund, 1885. The record based on the specimen from Geneva preserved in the Natural History Museum of London (GBIF occurrence 1055565715) is doubtful, as this locality is far away from the known distribution of the species and there are no recent valid records of the species. 6) *Porcellio sylvestris* Fabr. This species is mentioned by Pavesi (1873). However, the species is most probably a *nomen nudum*. The records may correspond to two other species: *Porcellio sylvestris* C. Koch, 1838, a synonym of *Trachelipus rathkii* according to Schmalfuss (2003), or to *Porcellio sylvestris* Sill, 1862 (sic), a synonym of *Trachelipus ratzeburgii* also according to Schmalfuss

(2003). Both valid species were recorded in Switzerland by Am Stein (1857). This would make a total of 44 valid species recorded in Switzerland.

In the present work, we report on six species new for Switzerland; five of them exotic, captured in heated greenhouses: *Buddelundiella cataractae* Verhoeff, 1930b (Fig. 3A-C); *Chaetophiloscia cellaria* (Dollfus, 1884) (Fig. 2C-D); *Miktoniscus linearis* (Patience, 1908) (Fig. 3D-E); *Nagurus cristatus* (Dollfus, 1889) (Fig. 2A-B); *Reductoniscus costulatus* Kesselyák, 1930 (Fig. 1A-C) and *Venezillo parvus* (Budde-Lund, 1885) (Fig. 1D-F), adding a total of 51 woodlice species for the country. Furthermore, we recorded nine species for the first time in any of the Swiss cantons, such as *Androniscus dentiger* Verhoeff, 1908a, *Haplophthalmus danicus* Budde-Lund, 1880, *Haplophthalmus mengii* (Zaddach, 1844), *Hyloniscus riparius* (C. Koch, 1838), *Oniscus asellus* Linnaeus, 1758, *Cylisticus convexus* (De Geer, 1778), *Porcellio scaber* Latreille, 1804, *Porcellionides pruinosus* (Brandt, 1833) and *Armadillidium nasatum* Budde-Lund, 1885.

The number of woodlice species recorded in Switzerland is similar, or a little higher, to that of other European countries of similar size. For example, Belgium harbours 39 species (4 exotic) according to De Smedt *et al*. (2017, 2018), Boeraeve *et al.* (2021), the Netherlands 42 species (7 exotic; Berg *et al*., 2008), Slovakia 45 species and the Czeck Republik 43 species (Tajovský *et al.,* 2018), and Hungary 57 species (3 exotic; Vilisics & Hornung, 2009). Other European countries, of larger size, have higher numbers of species. Giurginca *et al*. (2015) reported 89 species for Romania, and Séchet & Noël (2015) 218 species (7 exotic) for France and 350 species for Italy. On the other hand, the United Kingdom has 57 woodlice species, a number similar to that of Switzerland (at least 12 exotic; Gregory, 2009; https://www.bmig.org.uk). The diversity of habitats and landscapes is high in Switzerland, indicating that there may be further so far undetected species. Furthermore, several exotic species introduced to Europe have not yet been recorded in Switzerland (Cochard *et al*., 2010). These non-native species may establish populations in the country in the future.

The last comprehensive review of the Swiss woodlice fauna was published more than one century ago (Carl, 1911). The lack of Swiss woodlice specialists may hinder improved knowledge about the diversity and distribution of the various species in this taxonomical group in the country. Despite lacking a comprehensive published revision of the Swiss woodlice, the Centre Suisse de Cartographie de la Faune (CSCF) has an unpublished checklist of the Swiss Woodlice, which contains 42 species. There are some differences between the list of the CSCF and our checklist. We found 12 species in the literature that were not included in the CSCF list. However, the CSCF list contains four species that are not considered in our list (Table 4). These four species correspond to reliable unpublished records that have been validated by Pascal Stucki. These species are known from neigbouring countries, and it is to be expected that in the future, these and other species, have to be added to the Swiss checklist.

Heated greenhouses

Most individuals could be identified to species level, but 38 specimens could only be adscribed to one of two genera. One of them is most likely *Eubelum* Budde-Lund, 1885, with no other species in greenhouses or even outdoors Switzerland. Thus, this would add up to 18 species present in the greenhouses. This is roughly a third of the woodlice species of Switzerland (Table 2). Of the 17 identified species in the greenhouses, seven were introduced, non-native species, and six of them are new records for the country. These exotic species represent around 73% of the captured individuals in the greenhouses. Interestingly, two exotic species add more than half of the captures: *Venezillo parvus* (520 individuals; 42%) and *Reductoniscus costulatus* (176 individuals; 14%). However, the remaining species, which represent only a minor percentage of the captured individuals, are mostly cosmopolitan synanthropic species. The most common oudoor species in Switzerland are therefore less represented or even absent in heated greenhouses. Thus, despite the high diversity found, heated greenhouses are mainly inhabited by exotic species, and cosmopolitan synanthropic species. Vilisics & Hornung (2009) already pointed out that these artificial habitats harbour a mix of native and introduced species. These exotic species are favoured in the greenhouses because of the temperature and humidity conditions being more stable throughout the year and similar to their origin areas. Exotic woodlice species rarely invade the outdoor environments in urban or rural areas in Europe, but European, non-native species (mainly of Mediterranean origin) often do (Cochard *et al.,* 2010).

It is not clear why some of the species recorded by Carl (1908a, 1911) and Holzapfel (1932) in the botanical gardens of Zurich and Bern were not found in the recent survey. It is possible that the former authors included records outside of the greenhouses. However, it is also possible that the newly arrived exotic species, found at that time in these locations, have displaced the native ones in the greenhouses. On the other hand, Carl (1908a, 1911) and Holzapfel (1932) did not mention the exotic woodlice species found in our study (*M. linearis, N. cristatus*, *R. costulatus*, *T. tomentosa* and *V. parvus*), suggesting that these species arrived later to the greenhouses in Switzerland. These exotic species are currently known from other botanical gardens and greenhouses in Europe. One of the species, *T. tomentosa*,

has also been intentionally transported as it is used as nourishment for exotic pets and decomposer of organic remnants in terraria. Of the five newly recorded exotic woodlice species, *T. tomentosa*, was the earliest one being reported in a European greenhouse (in the Museum of Paris; Dollfus, 1896). The first records in European greenhouses of the remaining four exotic woodlice species were mostly published during the twentieth century. *Miktoniscus linearis*, was firstly recorded in the Kew Gardens in United Kingdom (Patience, 1908), *R. costulatus* in the Botanical Garden of Berlin, Germany (Kesselyák, 1930), and *N. cristatus* in several greenhouses in the Netherlands (Holthuis, 1945). The most recently arrived species is *Venezillo parvus*, recorded in the Zoo of Rotherdam, the Netherlands, by Soesbergen (2003). The proportion of non-native to native species of woodlice is similar to those found in spiders, centipedes and millipedes in the same greenhouses (Hänggi *et al*., 2021; Gilgado *et al*., 2022a). The same survey has also resulted in new species records for Switzerland in exotic spiders (Hänggi *et al*., 2021), centipedes and millipedes (Gilgado *et al*., 2022a), short-tailed whipscorpions (Krajčovičová *et al*., 2021), and silverfishes (Gilgado *et al*., 2021). Further research is needed to evaluate what factors (temperature, management, etc.) promote the richness and abundance of non-native arthropodod species. Alltogether, our results suggest that the managers of these greenhouses should keep working on the prevention of introduction of exotic invertebrates.

ACKNOWLEDGEMENTS

We are thankful to the greenhouse managers for allowing us to sample invertebrates, and to the gardeners for their assistance during sampling. We would like to specially thank Bruno Erny, David Meierhofer and Inayat Olmedo (Botanical Garden of the University of Basel); Michael Kessler, Peter Enz, René Stalder and Manfred Knabe (Botanical Garden of the University of Zurich), Damien Becker and Alain Mertz (Jurassica); Chantal Derungs and Nadja Fischer (Papiliorama Kerzers); Hanspeter Schumacher (Botanical Garden of St. Gallen); Didier Roguet, Nicolas Freyre and Vincent Goldschmidt (Conservatory and Botanical Garden of Geneva); Alain Mueller and Christine Jakob (Botanical Garden of the University of Fribourg); Markus Fischer and Bill Juerg (Botanical Garden of the University of Bern); and Friederike von Houwald (Basel Zoo). We are thankful to Professor Bruno Baur for providing us with the contacts of several of these managers, for his advice when we prepared the sampling design, and for his comments on an earlier version of the manuscript. We are grateful to the two anonymous reviewers for their suggestions. Thanks also to the Swiss Speleological Association (Basel Section), especially to Erich Plattner and Freddy Müller, for guiding us in the Bueberg Kaverne. We are also grateful to the SNP direction and SNP Research Commission who granted permission for fieldwork in the SNP and provided logistical help and funding. Additional funding was obtained from the 'Stiftung Sammlung Naturmuseum Chur'. We are also grateful to Yves Gonseth (CSCF) for providing information on the Swiss woodlice records. We thank Edi Stöckli (Naturhistorisches Museum Basel) and Ueli Rehsteiner and Stephan Liersch (Bündner Naturmuseum Chur) for helping in the preparation of the voucher collection for their museums. Thanks also to Ambros Hänggi (Naturhistorisches Museum Basel) for providing us with the pictures of *Chaetophiloscia cellaria*. We are also thankful to the University of Basel for proving funding for the research in the greenhouses.

REFERENCES

Am Stein J.H. 1857. Aufzählung und Beschreibung der Myriapoden und Crustaceen Graubündens. *Jahresbericht der Naturforschenden Gesellschaft Graubünden*, Neue Folge 2: 112-148.

Arcangeli A. 1913. Isopodi terrestri nuovi o poco noti di Italia. *Monitore zoologico italiano* 24: 183-202.

Bagnall R.S. 1909. On some terrestrial isopods from the Glasnevin Botanic Gardens, Dublin. *Irish Naturalist* 18: 42-44.

Berg M.P. 1997. Naamlijst van de Nederlandse landpissebedden (Crustacea: Isopoda: Oniscidea). *Nederlandse Faunistische Mededelingen* 7: 31-34.

Berg M.P., Soesbergen M., Tempelman D., Wijnhoven H. 2008. Verspreidingsatlas Nederlandse landpissebedden, duizendpoten en miljoenpoten (Isopoda, Chilopoda, Diplopoda). *EISNederland, Leiden & Vrije Universiteit-Afdeling Dierecologie, Amsterdam,* 192 pp.

Boeraeve P., Arijs G., Segers S., Brosens D., Desmet P., Swinnen K., Lambrechts J., De Smedt P. 2021. Inventory of the terrestrial isopods in Belgium (2011–2020). *In*: De Smedt P., Taiti S., Sfenthourakis S., Campos-Filho I.S. (eds). Facets of terrestrial isopod biology. *ZooKeys* 1101: 57-69.

Brandt I. 1833. Conspectus Monographiae Crustaceorum Oniscodorum Latreillii. *Byulleten moskovskogo Obshchestva Ispŷtateleĭ Prirodŷ* 6: 171-193 and plate 4.

Brandt I., Ratzeburg J. 1833. Isopoda. *In:* Medizinische Zoologie. *Berlin* vol. 2: 70-84 and plates 12-13.

Braschler B., Gilgado J.D., Zwahlen V., Rusterholz H.-P., Buchholz S., Baur B. 2020. Ground-dwelling invertebrate diversity in domestic gardens along a rural-urban gradient: Landscape characteristics are more important than garden characteristics. *PLoS ONE* 15 (10): e0240061.

Budde-Lund G. 1880. Isopoda [Oniscidea]. *In:* Meinert F., Crustacea Isopoda, Amphipoda et Decapoda Daniae. *Naturhistorisk Tidsskrift* 12: 467-470.

Budde-Lund G. 1885. Crustacea Isopoda terrestria per familias et genera et species descripta. *Typis Nielsen & Lydiche, Copenhagen*. 319 pp.

Budde-Lund G. 1893. Landisopoder fra Venezuela, insamlede of Dr. F. Meinert. *Entomologiske Meddelelser* 4: 111-129.

Budde-Lund G. 1908. Isopoda von Madagaskar und Ostafrika mit Diagnosen verwandter Arten. *In:* Voeltzkow A., Reise in Ostafrika in den Jahren 1903-1905. *Wissenschaftliche Ergebnisse*, vol. 2: 265-308 and plates 12-18.

Carl J. 1906. Beitrag zur Höhlenfauna der insubrischen Region. *Revue suisse de Zoologie* 14: 601-615.

Carl J. 1908a. Monographie der schweizerischen Isopoden. *Neue Denkschriften der schweizerischen naturforschenden Gesellschaft* 42: 107-242.

Carl J. 1908b. Etude sur les trichoniscides (isopodes terrestres) de la collection de M. A. Dollfus. *Feuille des jeunes Naturalistes* IV^e^ Série, 38: 169-172, 193-197, 220-223; 39: 15-21.

Carl J. 1911. Isopodes. *In:* Catalogue des Invertébrés de la Suisse. *Georg & Cie, Geneva,* vol. 4, VI + 68 pp.

Carpio-Díaz Y.M., López-Orozco C.M., Campos-Filho I.S., Navas G.R. S. 2018. Terrestrial isopods (Isopoda: Oniscidea) of the Botanical Garden of Cartagena "Guillermo Piñeres", Colombia, with the description of three new species. *Arthropoda Selecta* 27(4): 301-318.

Cochard P.-O., Vilisics F., Sechet E. 2010. Alien terrestrial crustaceans (Isopods and Amphipods). Chapter 7.1. *In:* Roques A. *et al.* (eds), Alien terrestrial arthropods of Europe. *BioRisk* 4(1): 81-96.

Cuvier G. 1792. Mémoire sur les cloportes terrestres. *Journal d'Histoire naturelle* (Paris) 2: 18-31 and plate 26.

Dahl F. 1916. Die Asseln oder Isopoden Deutschlands. *Gustav Fischer Verlag, Jena*. vi + 90 pp.

De Geer A. 1778. Des cloportes. *In:* Mémoires pour servir à l'histoire des insectes. *Imprimerie P. Hesselberg, Stockholm.* vol. 7, pp. 545 554 and plate 35.

De Smedt P., Arijs G., Segers S., Boeraeve P. 2017. Woodlice of the green houses at Ghent Botanical Garden and Botanic Garden Meise with two new exotic species for Belgium (Isopoda: Oniscidae). *Bulletin de la Société royale belge d'Entomologie* 153: 109-112.

De Smedt P., Boeraeve P., Arijs G., Segers S. 2018. Woodlice of Belgium: an annotated checklist and bibliography (Isopoda, Oniscidea). *In:* Hornung E., Taiti S., Szlavecz K. (eds), Isopods in a Changing World. *ZooKeys* 801: 265-304.

Dollfus A. 1884. Les espèces françaises du genre *Philoscia* Latreille. *Bulletin de la Société d'Etudes scientifiques de Paris* 7: 1-4.

Dollfus A. 1889. Sur quelques isopodes du Musée de Leyde. *Notes from the Leiden Museum* 11: 91-94 and plate 5.

Dollfus A. 1892. Tableaux synoptiques de la faune française, le genre *Armadillidium* (Crustacés Isopodes terrestres). *Feuille des jeunes Naturalistes* 22: 15-19, 135-141, 175-179.

Dollfus A. 1896. Recherches zoologiques dans les serres du Muséum de Paris. III. Crustacés isopodes terrestres. *Feuille des jeunes Naturalistes* 31: 93-94.

Dollfus A. 1897a. Liste des Mollusques testacés terrestres et des Crustacés isopodes recueillis aux environs de Pratteln (Jura bâlois). *Feuille des jeunes Naturalistes* 27 année: 70-74, 91-95.

Dollfus A. 1897b. Notes de Géographie zoologique. *Feuille des jeunes Naturalistes* 27: 205-212.

Dollfus A. 1904. Sur un nouveau genre et une nouvelle espèce de crustacé isopode fossile découvert à Bouzigues (Hérault). *Feuille des jeunes Naturalistes* 4me Série, 34: 145-146.

Farkas S. 2007. The terrestrial isopod fauna of South Transdanubia (Hungary). *Somogyi Múzeumok Közleményei. B - Természettudomány* 17: 159-168.

Farkas S., Vilisics F. 2013. Magyarország szárazföldi ászkarák faunájának határozója (Isopoda: Oniscidea). *Natura Somogyiensis* 23: 89-124.

Foster N.H. 1911. On two exotic species of woodlice found in Ireland. *The Irish Naturalist* 20: 154-156.

Gilgado J. D., Bobbitt I., Molero-Baltanás R., Braschler B., Gaju-Ricart M. 2021. Erstnachweis von *Nicoletia phytophila* Gervais, 1844 (Zygentoma, Nicoletiidae) in Gewächshäusern in der Schweiz. *Entomo Helvetica* 14: 113-116.

Gilgado J.D., Cabanillas D., Bobbitt I. 2022a. Millipedes and centipedes (Myriapoda: Diplopoda, Chilopoda) in Swiss heated greenhouses, with seven species new for Switzerland. *Revue suisse de Zoologie* 129(1): 85-101.

Gilgado J. D., Rusterholz H. P., Baur B. 2022b. Millipedes step up: species extend their upper elevational limit in the Alps in response to climate warming. *Insect Conservation and Diversity* 15(1): 61-72.

Giurginca A., Munteanu C.-M., Vlaicu M., Tabacaru I.-G. 2015. Cavernicolous Oniscidea of Romania. "Emil Racovitza" Institute of Speleology, Romanian Academy, *Ed. Semne, Bucarets.* 165 pp.

Gregory S.J. 2009. Woodlice and Waterlice (Isopoda: Oniscidea & Asellota) in Britain and Ireland. *Field Studies Council (FSC), Centre for Ecology & Hydrology,* 176 pp.

Gregory S.J. 2014. Woodlice (Isopoda: Oniscidea) from the Eden project, Cornwall, with descriptions of species new to britain and poorly known british species. *Bulletin of the British Myriapod & Isopod Group* 27: 3-26.

Gruner H. 1966. Die Tierwelt Deutschlands. 53. Teil. Krebstiere oder Crustacea. V. Isopoda 2. Lieferung. *Gustav Fischer Verlag, Jena.* pp. 151-380.

Hänggi A., Bobbitt I., Kranz-Baltensperger Y., Bolzern A., Gilgado J. D. 2021. Spiders (Araneae) from Swiss hothouses, with records of four species new for Switzerland. *Arachnologische Mitteilungen: Arachnology Letters* 62(1): 67-74.

Heller C. 1858. Beiträge zur österreichischen Grotten-Fauna. *Sitzungsberichte der Akademie der Wissenschaften in Wien. mathematisch-naturwissenschaftliche Klasse* 26: 313-326.

Hollier J. 2018. The woodlice (Crustacea: Isopoda) described by Henri de Saussure and Jean Carl. *Revue suisse de Zoologie* 125(1): 149-153.

Holthuis L. 1945. Notes on terrestrial Isopoda collected in Dutch greenhouses. *Zoologische Mededeelingen* 25: 43-54.

Holthuis L. 1947. On a small collection of isopod Crustacea from the greenhouses of the Royal Botanic Gardens, Kew. *Annals and Magazine of natural History* Series 11, 13: 122-137.

Holthuis L. 1948. Additions to the wild fauna and flora of the Royal Botanic Gardens, Kew, XX. Terrestrial isopod Crustacea. *Kew Bulletin*, 121-123.

Holthuis L. 1949. The Isopoda and Tanaidacea of the Netherlands, including the description of a new species of Limnoria. *Zoologische Mededelingen* 30(12): 163-190.

Holthuis L. 1956. Fauna van Nederland. Aflevering 16. Isopoda en Tanaidacea. *A.W. Slijthoff, Leyden*. 280 pp.

Holzapfel M. 1932. Die Gewachshausfauna der Berner Botanischen Gartens. *Revue suisse de Zoologie* 39: 325-374.

Hornung E. 2011. Evolutionary adaptation of oniscidean isopods to terrestrial life: Structure, physiology and behavior. *Terrestrial Arthropod Reviews* 4: 95-130.

Jaskul R., Sulikowska-Drozd A., Jablonska A., Banas K., Rewicz T. 2019. Undesirable immigrants: hobbyist vivaria as a potential source of alien invertebrate species. *PeerJ*, doi: 10.7717/peerj.7617

Jędryczkowski W. 1979. Synanthrope landisopoden (isopoda, oniscoidea) polens. *Fragmenta faunistica (Warsaw)* 25: 95-106.

Jędryczkowski W. 1981. Isopods (Isopoda) of Warsaw and Mazovia. *Memorabilia Zoologica* 34: 79-86.

Kesselyák A. 1930. Über Isopoden. *Zoologischer Anzeiger* 91: 50-66.

Kinahan J. 1857. Analysis of certain allied genera of terrestrial isopods; with description of a new genus, and a detailed list of the British species of *Ligia*, *Philougria*, *Philoscia*, *Porcellio*, *Oniscus* and *Armadillium* [sic]. *Natural History Review* 4: 258-282 and plates 19-22.

Koch C. 1838. Deutschlands Crustaceen, Myriapoden und Arachniden, ein Beitrag zur deutschen Fauna, Heft 22; *Regensburg (Pustet).*

Koch C. 1841. Deutschlands Crustaceen, Myriapoden und Arachniden, ein Beitrag zur deutschen Fauna, Heft 28-34; *Regensburg (Pustet).*

Kontschán J. 2004. Magyarország faunájára új ászkarák (*Reductoniscus constulatus* Kesselyák, 1930- Crustacea: Isopoda: Oniscidea) előkerülése az ELTE füvészkertjeből (Budapest). *Folia Historico Naturalia Musei Matraensis* 28: 89-90.

Korsós Z., Hornung E., Szlávecz K., Kontschán J. 2002. Isopoda and Diplopoda of urban habitats: new data to the fauna of Budapest. *Annales Historico-Naturales Musei Nationalis Hungarici* 94: 193-208.

Krajčovičová K., Gilgado J.D., Bobbitt I., Christophoryová J. 2021. New cases of introducion of *Stenochrus portoricensis* (Arachnida: Schizomida) in Switzerland. *Biharean Biologist* 15(1): 69-70.

Latreille P. 1802. Histoire Naturelle, Générale et Particulière des Crustacés et des Insectes, Tome Troisième. *F. Dufart, Paris.* 467 pp.

Latreille P. 1804. Histoire naturelle, générale et particulière, des crustacés et des insectes. Cloportides; vol. 7: 25-49. *F. Dufart, Paris.*

Legrand J. 1942. Les isopodes terrestres des environs de Paris. I. Description de quelques formes nouvelles. *Bulletin de la Société zoologique de France* 67: 153-161.

Legrand J. 1950. Les isopodes terrestres des Alpes de Savoie. *Bulletin de la Société zoologique de France* 75: 45-62.

Lereboullet A. 1853. Mémoire sur les crustacés de la famille des cloportides qui habitent les environs de Strasbourg. *Mémoires de la Société du Muséum d'Histoire naturelle de Strasbourg* 4: 1-130.

Linné C. 1758. Systema Naturae. Regnum Animalium. *Editio decima, Stockholm.* vol. 1, p. 637.

Meinertz T. 1934. Die Landisopoden Dänemarks. II. Die Onisciden. *Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere* 66: 211-284.

Meinertz T. 1936. Storkrebs. III. Ringkrebs. 2. Baenkebidere (Land- og Ferskvandsisopoder). *Danmarks Fauna* 42: 1-92; Copenhagen.

Miers E. J. 1877 (1878). On a collection of Crustacea, Decapoda and Isopoda, chiefly from South America, with descriptions of new genera and species. *Proceedings of the Zoological Society of London, London* 43 (1877): 653-679, pls 66-69.

Olsen K.M. 1995. *Cordioniscus stebbingi* (Patience, 1907) and *Trichorhina tomentosa* (Budde-Lund, 1893), two greenhouse woodlice (Isopoda, Oniscidea) new to Norway. *Fauna Norvegica* Ser. B, 42: 67.

Pack-Beresford D.R., Foster N.H. 1913. Additions to the distributional records of woodlice in Ireland. *The Irish Naturalist* 22: 45-48.

Patience A. 1908. On a new British terrestrial isopod (*Trichoniscus linearis* sp. n.). *Annals and Magazine of Natural History* 8: 280-282.

Pavesi P. 1873. Materiali per una fauna del Cantone Ticino. *Atti della Societá italiana di Scienze Naturali* 16: 24-54.

Polk P. 1959. Notes sur la distribution et la bibliographie des Oniscoidea de la Belgique. *Biologisch Jaarboek (Antwerpen)* 27: 452-460.

Racovitza E. 1908. Biospéologica. IX. Isopodes terrestres (seconde série). *Archives de Zoologie expérimentale et générale*, 4e Série, 9: 239-415.

Sars G. 1898. An Account of the Crustacea of Norway. Vol. 2. Isopoda, Tribe 5. Oniscoidea. *Christiania, A. Cammermeyer, Bergen,* pp. 153-192 and plates 70-83.

Say T. 1818. An account of the Crustacea of the United States. *Journal of the Academy of natural Sciences of Philadelphia* 1: 57-80, 97-101, 155-169, 235-253, 313-319, 374-401, 423-441, 445-458 and 1 plate.

Schmalfuss H. 2003. World catalog of terrestrial isopods (Isopoda: Oniscidea). *Stuttgarter Beiträge zur Naturkunde* Serie A, Nr. 654: 341 pp.

Schmidt C. 2003. Contribution to the phylogenetic system of the Crinocheta (Crustacea, Isopoda). Part 2. (Oniscoidea to Armadillidiidae). *Mitteilungen aus dem Museum für Naturkunde in Berlin* 79(1): 3-179.

Schnitzler H. J. 1853. De Oniscineis Agri Bonnensis. *Dissertatio zoologica, Köln,* pp. 1-26.

Schöbl J. 1860. *Haplophthalmus*, eine neue Gattung der Isopoden, mit besonderer Berücksichtigung der Mundtheile untersucht. *Zeitschrift für wissenschaftliche Zoologie* 10: 449-466.

Scopoli I. 1763. Entomologia carniolica exhibens Insecta Carnioliae indigena. Isopoda. Vindobonae. *Trattner, Vienna,* pp. 413-415.

Séchet E., Noël F. 2015. Catalogue commenté des Crustacés Isopodes terrestres de France métropolitaine (Crustacea, Isopoda, Oniscidea). *Mémoires de la Société Linnéenne de Bordeaux* 16: 156 pp.

Silvestri F. 1897. Descrizione di alcune nuove specie di isopodi della fauna mediterranea. *Annali del Museo civico di Storia naturale Giacomo Doria* 2: 413-416.

Soesbergen M. 2003. *Venezillo parvus* en *Synarmadillo* spec., twee nieuwe landpissebedden in Nederland (Crustacea: Isopoda: Armadillidae). *Nederlandse faunistische Mededelingen* 18: 97-101.

Strouhal H. 1953. Mitteilungen über einige paläarktische Isopoda terrestria. *Zoologischer Anzeiger* 151: 281-288.

Strouhal H. 1964. Die österreichischen *Haplophthalmus*-Arten der *mengii*-Gruppe (Isop. terr.). *Annalen des naturhistorischen Museums in Wien* 67: 499-558.

Taiti S., Ferrara F. 1996. The terrestrial Isopoda of Corsica (Crustacea, Oniscidea). *Bulletin du Muséum national d'Histoire naturelle* 4e série, 18(3-4): 459-545.

Tajovský K., Štrichelová J., Tuf I.H. 2018. Terrestrial isopods (Oniscidea) of the White Carpathians (Czech Republic and Slovakia). *In:* Hornung E., Taiti S., Szlavecz K. (eds), Isopods in a Changing World. *ZooKeys* 801: 305-321. https://doi.org/10.3897/zookeys.801.24133

Vandel A. 1946. Crustacés isopodes terrestres (Oniscoïdea) épigés et cavernicoles du Portugal. *Anaïs da Faculdade de Ciências do Porto* 30: 135-427.

Vandel A. 1960. Faune de France, vol. 64. *Isopodes terrestres (première partie)*. *Paris*, pp. 1-416.
Vandel A. 1962. Faune de France, 66. Isopodes terrestres (deuxième partie). *Paris*, pp. 417-931.
Verhoeff K. 1896. Ein Beitrag zur Kenntnis der Isopoda terrestria Deutschlands. *Zoologischer Anzeiger* 19: 18-23.
Verhoeff K. 1900. Über paläarktische Isopoden (2. Aufsatz). *Zoologischer Anzeiger* 23: 117-130.
Verhoeff K. 1901. Über paläarktische Isopoden (4. Aufsatz). *Zoologischer Anzeiger* 24: 66-79.
Verhoeff K. 1908a. Über Isopoden. *Androniscus* n. g. *Zoologischer Anzeiger* 33: 127-148.
Verhoeff K. 1908b. Neue Isopoden-Gattungen. *Zoologischer Anzeiger* 33(15): 520-525.
Verhoeff, K. 1908c. Über Isopoden. 12. Aufsatz. *Archiv für Naturgeschichte* 74: 163-198.
Verhoeff K. 1908d. Über Isopoden, 15. Aufsatz. *Archiv für Biontologie* 2: 335-387, pls 29-31.
Verhoeff K. 1917a. Zur Kenntnis und Entwicklung der Trachealsysteme und der Untergattungen von *Porcellio* und *Tracheoniscus* (Über Isopoden, 22. Aufsatz). *Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin*, 1917 (Nr. 3): 195-223. Berlin.
Verhoeff K. 1917b. Germania zoogeographica: Die Verbreitung der Isopoda terrestria im Vergleich mit derjenigen der Diplopoden. *Zoologischer Anzeiger* 48: 347-376.
Verhoeff K. 1917c. Zur Kenntnis der Gattungen *Trichoniscus* und *Mesoniscus*. *Zoologischer Anzeiger* 49: 40-57.
Verhoeff K. 1926. Ueber Isopoden der Balkanhalbinsel, gesammelt von Herrn Dr. I. Buresch. Zugleich 31. Isopoden-Aufsatz. *Mitteilungen der Bulgarischen Entomologischen Gesellschaft* 3: 135-156.
Verhoeff K. 1927a. Über einige südosteuropäischen Trichonisciden. *Zoologischer Anzeiger* 70: 200-223.
Verhoeff K. 1927b. Über einige zoogeographisch bedeutsame Isopoden-Arten. *Zoologischer Anzeiger* 73: 323-333.
Verhoeff K. 1928a. Über einige Isopoden der zoologischen Staatssammlung in München. 38. Isopoden-Aufsatz. *Zoologischer Anzeiger* 76: 25-36; 113-123.
Verhoeff K. 1928b. Über Stenonisciden. *Zoologischer Anzeiger* 79: 58-64.
Verhoeff K. 1930a. Über einige norditalienische Isopoden und einen neuen Typus der Volvation. *Zoologischer Anzeiger* 89: 162-177.
Verhoeff K. 1930b. Zur Kenntnis osteuropäischer Isopoden. *Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere* 59: 1-64 and plates 1-3.
Verhoeff K. 1931. Zur Kenntnis alpenländischer und mediterraner Isopoda terrestria. *Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere* 62: 1-52.
Verhoeff K. 1936. Studien über Isopoda terrestria. *Mitteilungen des zoologischen Museums Berlin* 21: 79-163.
Verhoeff K. 1938. Morphologisch-geographisch-ökologischer Beitrag zur Kenntnis der Isopoda terrestria von Oberwallis und Insubrien. *Archiv für Naturgeschichte* Neue Folge, 7: 317-363.
Verhoeff K. 1941. Grundlagen zur Beurteilung der geographischen Verbreitung der Landisopoden und über deren Fauna im westnordischen Gau. *Zeitschrift für Morphologie und Ökologie der Tiere* 37: 455-490.
Verhoeff K. 1949. Über Land-Isopoden aus der Türkei. III. *Istanbul Üniversitesi Fen Fakültesi Mecmuasi* Serı B, 14: 21-48.
Vilisics F., Hornung E. 2009. Urban areas as hot-spots for introduced and shelters for native isopod species. *Urban Ecosyst*, DOI 10.1007/s11252-009-0097-8
Vilisics F., Bogyó D., Sattler T., Moretti M. 2012. Occurrence and assemblage composition of millipedes (Myriapoda, Diplopoda) and terrestrial isopods (Crustacea, Isopoda, Oniscidea) in urban areas of Switzerland. *In:* Štrus J., Taiti S., Sfenthourakis S. (eds), Advances in Terrestrial Isopod Biology. *ZooKeys* 176: 199-214.
Wittenberg R. (ed.). 2005. An inventory of alien species and their threat to biodiversity and economy in Switzerland. CABI Bioscience Switzerland Centre report to the Swiss Agency for Environment, Forests and Landscape. The environment in practice no. 0629. *Federal Office for the Environment, Bern,* 417 pp.
Wouters K., Tavernier J.M., Meurisse L. 2000. Distribution and bibliography of the terrestrial Isopoda (Crustacea) of Belgium. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique* 70: 195-205.
Zaddach E. 1844. Synopseos Crustaceorum prussicorum Prodromus. *Königsberg*. 39 pp.
Zenker C. 1798. Descriptions of *Oniscus pulchellus* and *Oniscus cinereus*. *In:* Panzer G., Faunae insectorum Germanicae initia, oder Deutschlands Insecten. *Nürnberg (Felsecker)* Heft 62, pp. 21, 22.

Revue suisse de Zoologie (September 2022) 129(2): 369-374 ISSN 0035-418

First record of the spider genus *Tanzania* Koçak & Kemal, 2008 from Asia, with the description of a new species (Araneae: Salticidae)

Dhruv A. Prajapati[1, 2,*] & Ashutosh V. Dudhatra[3]

[1] *Web Of Nature (WON) Research Foundation, Ahmedabad, Gujarat 380058, India*
[2] *Research and Development Centre, Bharathiar University, Coimbatore 641014, India*
[3] *Jaslok Hospital & Research Centre, Peddar Road, IT Colony, Tardeo, Mumbai, Maharashtra 400026, India*
[*] *Corresponding author: dhruvspidy215@gmail.com*

Abstract: The jumping spider genus *Tanzania* Koçak & Kemal, 2008, which was previously only known from Africa, is recorded from Asia for the first time. The detailed morphology-based description and illustrations of a new species, *T. yellapragadai* sp. nov. (♂♀) from the Gujarat State of India, are provided.

Keywords: Taxonomy - jumping spider - Euophryini - Gujarat - India.

INTRODUCTION

The euophryine genus *Tanzania* Koçak & Kemal, 2008 was established by Wesołowska & Russell-Smith, 2000 with the description of three species from Africa, *Tanzania minutus* (Wesołowska & Russell-Smith, 2000), *Tanzania mkomaziensis* (Wesołowska & Russell-Smith, 2000) and *Tanzania pusillus* (Wesołowska & Russell-Smith, 2000). Later, Haddad & Wesołowska, 2011 and Wesołowska *et al.*, 2014 added three more species: *Tanzania meridionalis* Haddad & Wesołowska, 2011, *Tanzania parvulus* Wesołowska, Azarkina & Russell-Smith, 2014 and *Tanzania striatus* Wesołowska, Azarkina & Russell-Smith, 2014. So far, the genus Tanzania was known only from the Afrotropical Region (World Spider Catalog, 2022). In the present study we report the occurrence of the genus for the first time from Asia and describe a new species.

MATERIAL AND METHODS

Specimens were studied using a Leica M205 A stereo microscope. All measurements are in millimetres (mm). Palp and leg segment lengths are given as follows: total [femur, patella, tibia, metatarsus (except for palp), tarsus]. Drawings were made with the aid of a drawing tube attached to a microscope. Digital images were taken by a Leica DFC2900 digital camera attached to a Leica M205A stereo microscope with the software package Leica Application Suite (LAS), version 4.5.0. The type specimens were deposited in the reference collection of the Department of Zoology, Gujarat University, Ahmedabad, Gujarat.

Abbreviations used in the text: ALE = anterior lateral eye, AME = anterior median eye, CD = copulatory duct, PLE = posterior lateral eye, PME = posterior median eye, I-IV = 1st to 4th legs.

TAXONOMY

Genus *Tanzania* Koçak & Kemal, 2008

Type species: *Tanzania mkomaziensis* (Wesołowska & Russell-Smith, 2000).

Diagnosis: For diagnostic features of the genus see Wesołowska *et al.*, 2014.

Tanzania yellapragadai sp. nov.

Figs 1-13

Type material: GUZ99575A; male holotype; India, Gujarat, Rajkot, Khirasara, 22.217501°N, 70.650018°E; 138 m a.s.l.; 5.10.2020; leg. A. V. Dudhatra. – GUZ99575B; 1 female paratype; collected together with the holotype.

Etymology: This species is dedicated to the Indian biochemist Dr Yellapragada Subba Rao (1895-1948). He discovered the function of ATP and also developed Methotrexate, one of the first chemotherapy agents

Manuscript accepted 28.06.2022
DOI: 10.35929/RSZ.0082

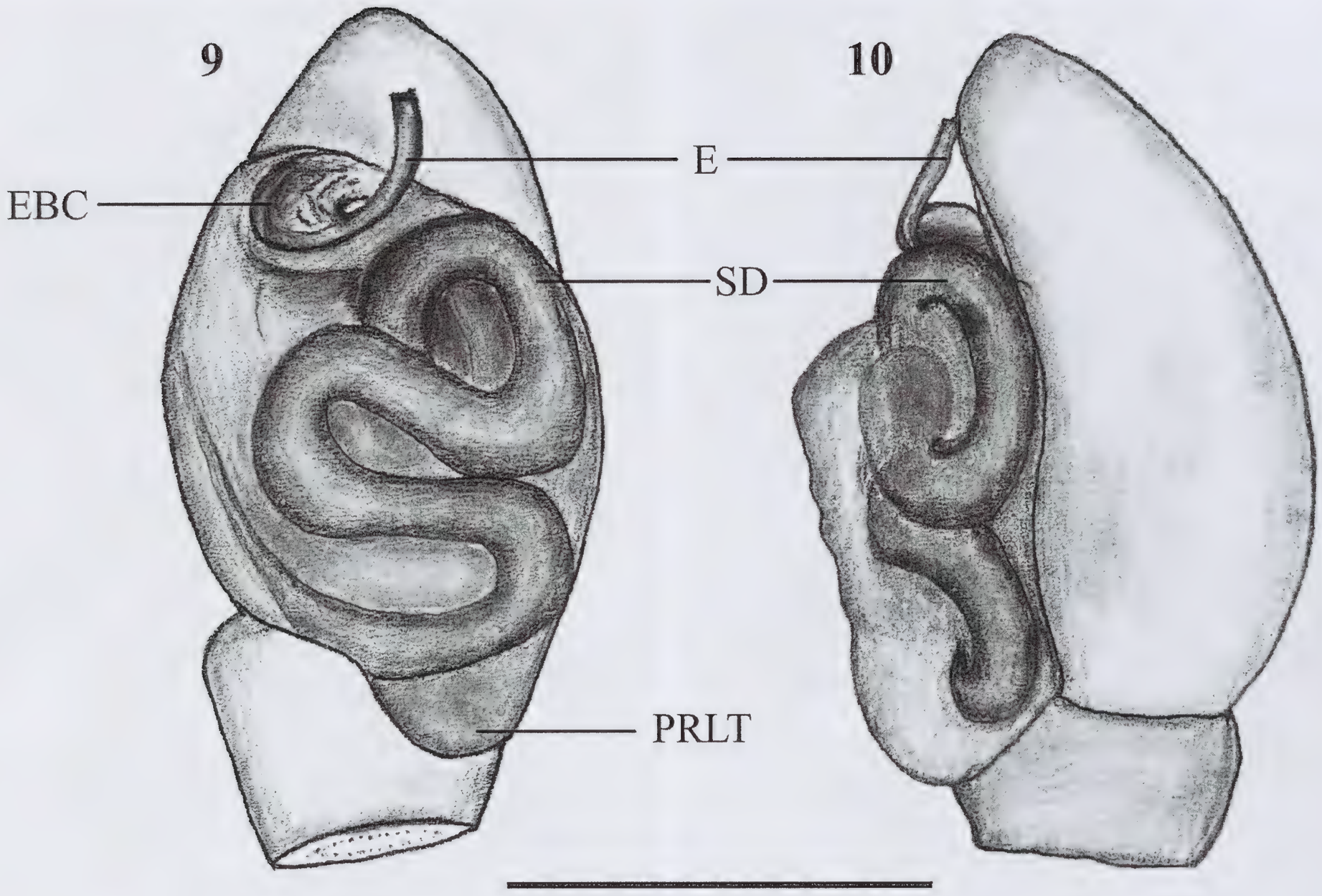
Figs 1-6. Photographs of living individuals of *Tanzania yellapragadai* sp. nov.; dorsal view (1-2), lateral view (3-4), frontal view (5-6). (1, 3, 5) Male holotype. (2, 4, 6) Female paratype. Arrows indicate enlarged clypeal setae.

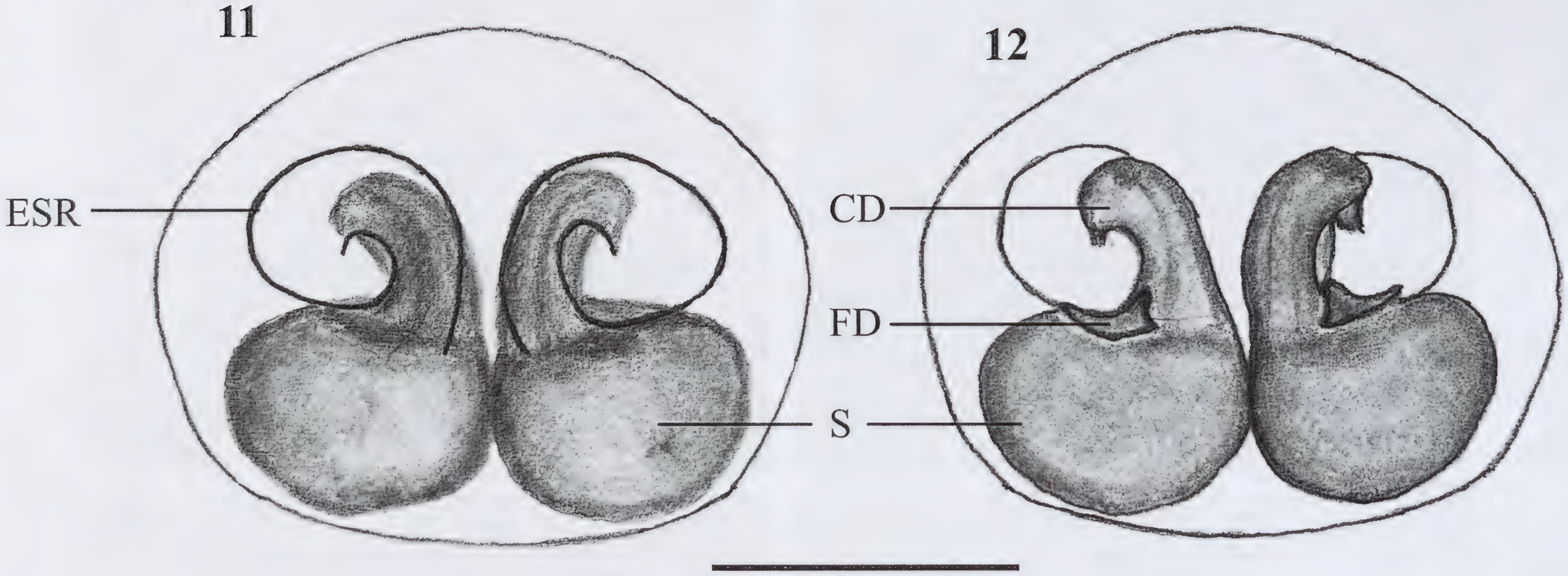
Figs 7-8. *Tanzania yellapragadai* sp. nov. (7) Habitus of male holotype, dorsal view. (8) Habitus of female paratype, dorsal view. Scale lines: 0.5 mm (8); 0.2 mm (7).

that is still widely used in cancer treatment and various autoimmune diseases.

Diagnosis: The new species is similar to *T. mkomaziensis* from which it can be distinguished by the following combination of characters: basal embolic coil very broad (Fig. 9; much narrower in *T. mkomaziensis*, see Wesołowska & Russell-Smith, 2000: fig. 165 and Wesołowska & Tomasiewicz, 2008: fig. 92); embolus short (Fig. 9; longer in *T. mkomaziensis*, see Wesołowska & Russell-Smith, 2000: fig. 165 and Wesołowska & Tomasiewicz, 2008: fig. 92); epigynal spiral ridges separated (Fig. 11; attached to each other in *T. mkomaziensis*, see Wesołowska & Russell-Smith, 2000: fig. 169 and Wesołowska & Tomasiewicz, 2008: fig. 94); spermathecae oval (Figs 11-12; in *T. mkomaziensis* spherical, see Wesołowska & Russell-Smith, 2000: figs 169-170 and Wesołowska & Tomasiewicz, 2008: fig. 94); colour pattern in males very different (Figs 1, 3, 5, 7 cf. Wesołowska & Russell-Smith, 2000: fig. 163).

Description: *Male holotype*: Carapace, chelicerae, palpal coxae, first two pairs of legs and femora of palp as well as legs I-IV dark black. Carapace pear-shaped and shiny, with scattered blackish setae; cephalic region raised, with several blackish setae above the anterior eye row; one long, curved blackish seta on clypeus below the AMEs (Fig. 1; indicated by an arrow); thoracic region slanting down to posterior margin. Chelicerae with two promarginal teeth and a single retromarginal tooth. All segments of legs I-II as well as femora of pedipalp and legs III-IV with iridescent lateral surface (Figs 3, 5); femur III with prominent reddish orange apical tip (Figs 1, 3, 5); legs III-IV (except their femora) with black and yellowish brown annuli; palpal tibia and cymbium covered with whitish setae ventrally. Abdomen oval, brownish black, with 3-4 posterior depressions; three patches of whitish setae along with a whitish band laterally, scattered reddish brown setae and long blackish setae dorsally (Fig. 7). Spinnerets blackish, a group of bright whitish setae situated at the rear of the abdomen, right above the spinnerets (Figs 1, 3, 7). Body length 1.29. Carapace length 0.68, width 0.57, height 0.37. Abdomen length 0.61, width 0.53, height 0.34. Eye diameters: ALE 0.09, AME 0.15, PLE 0.09, PME 0.02. Eye interdistances: AME-AME 0.01, AME-ALE 0.01, ALE-ALE 0.39, ALE-PME 0.12, PLE-PLE 0.50, PME-PME 0.52, PME-PLE 0.05. Measurements of palp and legs: palp 0.53 [0.22, 0.08, 0.06, 0.17], I 0.94 [0.33, 0.14, 0.21,





Figs 9-12. Copulatory organs of *Tanzania yellapragadai* sp. nov. (9) Left pedipalp of male holotype, ventral view. (10) Same, retrolateral view. (11) Epigyne of female paratype, ventral view. (12) Vulva of same specimen, dorsal view. Scale lines: 0.1 mm. Abbreviations: CD = copulatory duct; E = embolus; EBC = basal coil of embolus; ESR = spiral ridge of epigynal opening; FD = fertilization duct; PRLT = proximal-retrolateral lobe of tegulum; S = spermathecae; SD = sperm duct.

0.16, 0.10], II 0.92 [0.30, 0.12, 0.17, 0.14, 0.19], III 1.31 [0.51, 0.15, 0.28, 0.21, 0.16], IV 1.21 [0.42, 0.11, 0.32, 0.19, 0.17]. Leg formula: 3412. Spination: palp spineless; legs: femora I-IV 0000; patellae I-IV 0000; tibia I 0004, II 0002, III 0001, IV 0000; metatarsi I-II 0004, III 2010, IV 1012; tarsi I-IV 0000. Pedipalps yellowish white except for blackish femur. Palpal tibia without retrolateral apophysis (Fig. 10). Embolus flat, ribbon shaped, with very broad basal embolic coil (Fig. 9). Tegulum with shallow proximal-retrolateral lobe; sperm duct meandering (Fig. 9).

Female paratype: As the male except as follows: Carapace dark brownish, covered with whitish setae. Chelicerae and palpal coxae brownish. Femora I-IV dark brownish, with less pronounced orange tip. Abdomen oval in shape, brownish with yellowish lateral sides, two pairs of pale yellowish patches situated antero-dorsally, a mosaic pattern postero-dorsally (Fig. 8). Body length 1.42. Carapace length 0.76, width 0.66, height 0.42. Abdomen length 0.87, width 0.74, height 0.45. Eye diameters: ALE 0.10, AME 0.17, PLE 0.10, PME 0.03. Eye interdistances: AME-AME 0.01, AME-ALE 0.01, ALE-ALE 0.40, ALE-PME 0.14, PLE-PLE 0.52, PME-PME 0.56, PME-PLE 0.06. Measurements of palp and legs.

Fig. 13. Habitat at the type locality.

Palp 0.57 [0.23, 0.08, 0.07, 0.19], I 1.10 [0.37, 0.17, 0.24, 0.19, 0.13], II 1.01 [0.34, 0.15, 0.21, 0.17, 0.14], III 1.48 [0.56, 0.18, 0.32, 0.24, 0.18], IV 1.38 [0.46, 0.14, 0.35, 0.22, 0.21]. Leg formula: 3412. Spination: palp spineless; legs: femora I-IV 0000; patellae I-IV 0000; tibia I 0003, II 0001, III 0010, IV 0000; metatarsus I 0004, II 0013, III 2022, IV 1021; tarsi I-IV 0000. Epigynal openings with spiral ridge, separated from each other (Fig. 11). Spermathecae bean-shaped, with simple copulatory duct arising anterolaterally (Fig. 12).

Distribution: The new species is known only from its type locality in India (Gujarat).

Habitat: The type specimens were collected from the litter of a grassland bordering Khirasara vidi (Fig. 13). "Vidi" is the local term used by the Forest Department of the State for a region which is characterized by a hot semi-arid climate and typically by a thorn scrub vegetation with a high proportion of grasses. This is commonly also referred to as a "scrub savanna". These vidis are used for livestock grazing by pastoral communities. There are many vidis in the Gujarat State of India, and Khirasara vidi is one of them.

Note: The male of *Tanzania yellapragadai* sp. nov. has its first two pairs of legs more iridescent than the female (Figs 3, 5 cf. Figs 4, 6). Moreover, the third pair of legs in the male has a conspicuous bright orange tip on its femur III, which is less pronounced in the female (Figs 1, 3, 5 cf. Figs 2, 4, 6). All of these characters presumably play a role in courtship behaviour.

ACKNOWLEDGEMENTS

We are thankful to Miss Priyal Prajapati (Web of Nature Research Foundation, India) for her generous help in preparing the figure plates. We are also grateful to Dr Peter Schwendinger (Natural History Museum of Geneva, Switzerland) and Dr Wanda Wesołowska (University of Wroclaw, Poland) for their comments and valuable suggestions on the manuscript.

REFERENCES

Haddad C.R., Wesołowska W. 2011. New species and new records of jumping spiders (Araneae: Salticidae) from central South Africa. *African Invertebrates* 52(1): 51-134.

Koçak A.Ö., Kemal M. 2008. New synonyms and replacement names in the genus group taxa of Araneida. *Centre for Entomological Studies Ankara, Miscellaneous Papers* 139-140: 1-4.

Wesołowska W., Azarkina G.N., Russell-Smith A. 2014. Euophryine jumping spiders of the Afrotropical Region – new taxa and a checklist (Araneae: Salticidae: Euophryinae). *Zootaxa* 3789(1): 1-72.

Wesołowska W., Russell-Smith A. 2000. Jumping spiders from Mkomazi Game Reserve in Tanzania (Araneae Salticidae). *Tropical Zoology* 13(1): 11-127.

Wesołowska W., Tomasiewicz B. 2008. New species and records of Ethiopian jumping spiders (Araneae, Salticidae). *Journal of Afrotropical Zoology* 4: 3-59.

World Spider Catalog 2022. World Spider Catalog. Version 23.0. Natural History Museum Bern. Available from: http://wsc.nmbe.ch (accessed 18 June 2022).

Revue suisse de Zoologie (September 2022) 129(2): 375-424 ISSN 0035-418

A taxonomic revision of the *Liphistius birmanicus*-group (Araneae: Liphistiidae) with the description of five new species

Peter J. Schwendinger[1*], Siegfried Huber[2], Christina Lehmann-Graber[1], Hirotsugu Ono[3], Mu Mu Aung[4] & Komsan Hongpadharakiree[5]

[1] *Muséum d'histoire naturelle de Genève, C.P. 6404, CH-1211 Genève 6, Switzerland*
[2] *Ottenbohlstrasse 12, D-88690 Mühlhofen, Germany*
[3] *Department of Zoology, National Museum of Nature and Science, 4-1-1 Amakubo, Tsukuba, Ibaraki 305-0005, Japan*
[4] *Forest Research Institute, Forest Department, Ministry of Natural Resources and Environmental Conservation, Yezin, Nay Pyi Taw, Myanmar*
[5] *Sirinart Rajini Mangrove Ecosystem Learning Center, Pranburi, Prachuab Khiri Khan Province, Thailand*
[*] *Corresponding author: peter.schwendinger@ville-ge.ch*

Abstract: Most of the species of the *Liphistius birmanicus*-group are revised on the basis of genital morphology and an identification key to all species is given. Twelve species are recognized: seven previously known, five new. *Liphistius metopiae* Schwendinger, sp. nov. from northern Thailand, and *L. tung* Schwendinger, sp. nov., *L. ferox* Schwendinger & Huber, sp. nov., *L. cupreus* Schwendinger & Huber, sp. nov. and *L. platnicki* Schwendinger & Huber, sp. nov. from eastern Myanmar are described from both sexes. New males and females of *L. birmanicus* Thorell, 1897, *L. pinlaung* Aung *et al*., 2019 and *L. pyinoolwin* Xu *et al*., 2021 from the type localities are illustrated. A new locality each for *L. birmanicus* and for *L. pinlaung* is reported; additional taxonomic characters of the type specimens of *L. lahu* Schwendinger, 1998 are shown. Illustrations of intraspecific variation among the new specimens and information on their biology are given. The presumed relationships within the *birmanicus*-group and between this group and other species groups in *Liphistius* are discussed. Lateral pockets in the uterus externus, a previously overlooked structure of unknown function in the female genitalia of *Liphistius* species, are illustrated.

Keywords: Arachnida - Mesothelae - trapdoor spiders - morphology - variation - biology - Myanmar - Thailand.

INTRODUCTION

The *Liphistius birmanicus*-group, established by Schwendinger (1998: 28), previously contained seven species: *L. birmanicus* Thorell, 1897, *L. lordae* Platnick & Sedgwick, 1984, *L. pinlaung* Aung, Xu, Lwin, Sang, Yu, Liu, Liu & Li, 2019, *L. hpruso* Aung, Xu, Lwin, Sang, Yu, Liu, Liu & Li, 2019 and *L. pyinoolwin* Xu, Yu, Aung, Yu, Liu, Lwin, Sang & Li, 2021 from Myanmar, *L. lahu* Schwendinger, 1998 from Thailand and *L. nabang* Yu, Zhang & Zhang, 2021 from China (World Spider Catalog, 2022). The recent discovery of a *Liphistius* in southern China, the northernmost species known so far in this genus, was surprising but not unexpected. Congeneric species from territories in Myanmar that lie not very far south of the Chinese type locality were already known to us and are described here. *Liphistius tanakai* Ono & Aung, 2020, known only from the female holotype collected on an island off the coast of southern Myanmar, appears to belong to the *trang*-group. Many more undescribed species presumably live in the mountainous parts of the eastern half of Myanmar. It is a challenge to find out how far to the west in Myanmar *Liphistius* occurs. In the east the mighty Mekong River appears to be an important, though not absolute biogeographical barrier for the genus (Schwendinger, 2013). The Sittoung (= Sittang) River in Myanmar, and possibly the Ayeyarwady (= Irrawaddy) River to the north of it, currently appears to mark the western limits of the geographical range of *Liphistius*. Does the species also occur in the Bago Yoma Mountain Range between these two rivers? No liphistiid spiders were discovered there during a one-day visit to the Bago Yoma Mountains by the first two authors (PJS and SH) in 2014, nor during an expedition to that region by members of the Japanese National Museum of Nature and Science in August 2018 (Ono & Aung, 2020: 89). How far north does *Liphistius* occur? The type locality of *L. nabang* in

Manuscript accepted 05.07.2022
DOI: 10.35929/RSZ.0083

China is so far the northernmost locality for the genus, but mesothelid fossils from Cretacious amber have been found much further north in the Hukaung Valley of the Kachin State (Wunderlich, 2017). They belong to extinct families, but it is likely that their modern descendants still live there today.

Since the publication of a comprehensive synopsis by Pocock (1900), not much substantial information on extant spiders (in contrast to fossil spiders in Burmese amber) of Myanmar has come out, which is mostly due to political issues in the country. Renewed collecting efforts during the last years (see Aung *et al*., 2019; Ono & Aung, 2020; Xu *et al*., 2021; Ono & Aung, 2022; this paper) will hopefully lead to a renaissance in research and publications on the spider fauna of Myanmar. There is so much more to be discovered in this biologically rich and diverse country.

MATERIAL AND METHODS

Morphological methods: Morphological characters were studied and drawn with a Zeiss SV11 stereomicroscope and an attached drawing tube. Whenever possible, female copulatory organs were drawn and examined from exuviae. Vulvae of alcohol-preserved specimens were cleared of soft tissue with fine forceps, insect pins and a paintbrush. Clearing in KOH was avoided, because it often leads to some degree of deformation (bulging) of the vulval plate. The ventral cuticular wall of the female genital region was cut off with micro-scissors to allow an unimpeded view of the ventral side of the vulval plate. Photos of vulval plates were taken with a video camera attached to a Zeiss SV6 stereomicroscope and stacked with the Automontage©System. Terminology of genital structures follows Schwendinger & Ono (2011) and Schwendinger (2017). Opisthosomal tergites are numbered from anterior to posterior, with the anterior-most being tergite I. Body measurements are all in mm (for other measurements the units are given) and were taken on the dorsal side, between the midpoints of the anterior and posterior margins. Total length includes chelicerae and anal tubercle. The carapace length was measured with the carapace in a slightly forward-inclined position so that the anterior and posterior margins were at the same focal plane. Leg and palp lengths are given in the following manner: total length (femur + patella + tibia + metatarsus + tarsus). In the paragraph "Variation" only characters that are considered to be taxonomically relevant are mentioned. In a few drawings some of the strong bristles on the cumulus and on the palpal tarsus were cut off virtually above the base to make the underlying structures better visible and to reduce the size of the figures. On the corresponding specimens these bristles remain intact. In the figure legends references to illustrations that are to the same scale are separated by commas, references to illustrations of different scales by semi-colons.

The type specimens of *L. birmanicus*, *L. lordae* and *L. pyinoolwin* were not re-examined because new material of both sexes is available from the corresponding type localities. The female syntypes (one of them meanwhile the lectotype) of *L. birmanicus* were re-described (also re-examined in all cases?) by Pocock (1900: 156), Bristowe (1933: figs 6, 7b, 8d, 9a), Haupt (1983: 280, figs 5C, 6C) and by Xu *et al*. (2021: 51, fig. 10G-H).

Map: The distribution map (Fig. 1) was created with simplemappr (www.simplemappr.net).

Museum acronyms: AMNH = American Museum of Natural History, New York, USA; BRCM = Biodiversity Research Centre of Myanmar, Nay Pyi Taw, Myanmar (note: until this collection is fully operational, all specimens destined to be deposited there will be temporarily stored in the NMNS); CBEE = Centre for Behavioural Ecology and Evolution, College of Life Sciences, Hubei University, Wuhan, Hubei Province, China; MCSNG = Museo Civico di Storia Naturale, Genova, Italy; MHBU = Museum of the Hebei University, Baoding, China; MHNG = Muséum d'histoire naturelle de la Ville de Genève, Switzerland; NMNS = National Museum of Nature and Science (formerly National Science Museum), Ibaraki, Japan; THNHM = Thailand Natural History Museum, Pathumthani, Thailand.

Other abbreviations used in the text: AME = anterior median eyes; CDO = central dorsal opening (macro-pore) of poreplate; CL = carapace length; CW = carapace width. Additional abbreviations are explained in the corresponding figure legends.

Arrangement of species: The presentation of species in this text is more or less in geographical order, from south to north, starting with the species in Thailand (Fig. 1).

TAXONOMIC PART

The *birmanicus*-group

When this species group was defined by Schwendinger in 1998 it contained only three species (*L. birmanicus, L. lordae* and *L. lahu*). As four additional species were added later and five are newly described here, a refined diagnosis and description of this group is necessary and given in the following.

Diagnosis: Essentially distinguished by the following four characters: (1) Contrategular area below (proximal of) tegulum completely unpigmented (e.g. Figs 8F, H-I, 13F-G, 21K, M, 23L-M). In males of all other species groups this area is more or less extensively pigmented. (2) A more or less distinct (least so in *L. platnicki* sp. nov., Fig. 23F) proximal ledge on retrodorsal side of contrategulum (e.g. Fig. 4A-C, G). A similar ledge is present only in *L. desultor* Schiödte, 1849, but

there it is situated medially, not proximally, and its most prominent part is on the proventral side, not on the retroventral side (Schwendinger *et al*., 2019: fig. 5F-G, I-K). (3) Embolus proper narrowly divided, with a longer sclerotised part and a distinctly shorter membranous part lying close to each other (e.g. Fig. 4C-D, G). This is also found in the *bristowei*- (e.g. Schwendinger, 1990: figs 57-59), *malayanus*- (e.g. Schwendinger, 2017: fig. 3B, D, F, H), *tioman*-, *linang*- and *batuensis*-group, whereas in the *trang*-group the embolus is widely divided, with both parts clearly apart from each other (Schwendinger, 1990: figs 60-62; Schwendinger, 2017: fig. 3A, C, E, G). (4) Poreplate with a pair of more or less developed (least so in *L. nabang* and *L. cupreus* sp. nov., Yu *et al*., 2021: fig. 4 and Fig. 22) anterior lobes (e.g. Fig. 5). The females of several species in the *malayanus*-, *tioman*-, *linang*- and *batuensis*-group also have pronounced anterior lobes on their poreplates, but these co-occur with either a very large receptacular cluster, a very large CDO or a reduced sclerotisation of the posterior part of the poreplate and/or of the posterior stalk (see various illustrations in Schwendinger, 2017).

Additions to description: Medium-sized to very large species (CL of males 4.92-12.67, CW 4.56-11.47). All males and the females of most species with a brown to almost black body colouration, often with annulated legs (Figs 2, 3A-D); only in *L. birmanicus* and *L. hpruso* females with yellow or orange-coloured areas on carapace and proximal portions of legs and palps (Fig. 3E-I). Males with medium-sized tibial apophysis, triangular in ventral view, usually not much set back from distal margin of palpal tibia (e.g. Fig. 6K, N; except in *L. tung* sp. nov., Fig. 8B), carrying four long tapering apical megaspines (e.g. Fig. 4F). Paracymbium rather short, moderately deep, with indistinctly conical, almost plane distal side (e.g. 4H-J), or with distinctly conical distal side (only in *L. cupreus* sp. nov., *L. platnicki* sp. nov. and *L. nabang*, Figs 21A, 23A, Yu *et al*., 2021: fig. 3D-F), and with (e.g. Fig. 6L) or without (e.g. 10A) a retrolateral-proximal heel; the latter widely (e.g. Figs 4H-I, 15G) or narrowly rounded (e.g. Figs 6L, 19F), in *L. lordae* heel protruding proximally (Fig. 17G), in all other cases retrolaterally (e.g. Fig. 6J, L-N); cumulus not or only indistinctly elevated (e.g. Fig. 4H-J), or distinctly elevated (only in *L. cupreus* sp. nov., *L. platnicki* sp. nov. and *L. nabang*, Figs 21B, 23A-B, Yu *et al*., 2021: fig. 3D-F), carrying several long, strong bristles. Ventral side of palpal tarsus with a distinct subdistal suture (Figs 21A, 23A), with a subdistal trench or without any depression there; distal margin of palpal tarsus widely but shallowly invaginated (e.g. Fig. 4G). Subtegulum with (e.g. Fig. 10A, G) or without (e.g. Fig. 21A, K, M) a small apophysis, never with a large one. Tegulum well-developed and wide; its distal margin not elevated in most species (e.g. Fig. 8F-G), only in *L. nabang* and *L. platnicki* sp. nov. distinctly elevated into a short wide keel (Yu *et al*., 2021: fig. 3A-B, D-E and Fig. 23I-M); proximal margin of tegulum with a wide, finely to coarsely dentate edge, in most species more or less bent and overhanging the unpigmented membranous contrategular area below it (e.g. Fig. 6F) or adpressed to it (e.g. Fig. 10B), only in *L. platnicki* sp. nov. straight and strongly salient (Fig. 23M). Pigmented bridge between tegulum and contrategulum on retrodorsal side of palpal organ well developed. Contrategulum carrying a medium-sized, more or less conical proventral process with a rounded (e.g. Fig. 4A-C) or widely truncate apex (Fig. 17A, C), in most species at a roughly 45-90° angle to the axis of the palpal organ (e.g. Fig. 4G), in *L. birmanicus* and *L. pinlaung* distad-directed, almost parallel to axis of palpal organ (Figs 13D, F, 15C, E); distal edge of contrategulum narrow (e.g. Fig. 21E) to wide (e.g. Fig. 19A), its prolateral part with a more (e.g. Fig. 6I) or less (e.g. Fig. 4G) elevated keel, its prodorsal part evenly arched (e.g. 4A-C), or with an angular (in *L. cupreus* sp. nov., Fig. 21A, E-F, H-I) or arched protrusion (in *L. nabang,* Yu *et al*., 2021: fig. 3B); retrodorsal side of contrategulum with a pronounced (e.g. Fig. 4A-C, G) or rather small (only in *L. cupreus* sp. nov., *L. platnicki* sp. nov. and *L. nabang*, Figs 21E-F, H-I, N, 23F, H-I, Yu *et al*., 2021: fig. 3A-B) proximal ledge; contrategular area proximal of tegulum completely unpigmented (e.g. Fig. 8F-I). Para-embolic plate short in most species, with (e.g. Fig. 6F-H) or without (e.g. Fig. 4C-D) a slight indentation between it and keel-shaped retroventral edge of embolus complex; in *L. tung* sp. nov. and *L. ferox* sp. nov. para-embolic plate long and tounge-shaped (Figs 8A, I-H, 10A-D). Retrolateral margin of embolus complex unpigmented and overhanging distal margin of tegulum (e.g. Fig. 8F-G); prolateral margin of embolus complex with a lobate protrusion in *L. pyinoolwin* (Fig. 19A-B), unmodified in all other species of the group. Embolus proper narrowly divided; its sclerotised part strengthened by 2-6 ribs reaching apex; only in *L. ferox* sp. nov. with 2 ribs, one of them carrying a triangular distal protrusion (Fig. 10E-H); in distal view retrolateral side of sclerotised embolus part rounded and concave in most species, only in *L. ferox* sp. nov. angular (Fig. 10H); membranous part of embolus proper distinctly shorter than sclerotised part, at its base a more or less strongly pigmented area with longitudinal or inclined wrinkles (e.g. Figs 6I, 13D). Females with lateral folds of vulval plate well developed, glabrous or carrying few to several hairs; no hairs in genital atrium, and only exceptionally a single hair on poreplate or on posterior stalk (Figs 16I, 18E). Poreplates mostly wider than long (with only very few exceptions, e.g. Fig. 22N), with a more or less strongly invaginated anterior margin (slightly arched only in one documented female of *L. nabang*, Yu *et al*. 2021: fig. 4E-F) carrying a pair of

anterior lobes ranging from large and wide (in *L. lordae*, Fig. 18) to small and reduced to 1-2 clusters of vesicles (in *L. cupre*us sp. nov., Fig. 22 and *L. nabang*, Yu *et al*., 2021: fig. 4); lateral margins of poreplate ventrally with (e.g. Fig. 7) or without small, knob-shaped antero-lateral processes (e.g. Fig. 5); CDO mostly small (e.g. Fig. 5A), slightly larger only in *L. tung* sp. nov. (Fig. 9A, C, E), distinctly larger only in juveniles (Fig. 9G), mostly rounded (e.g. Fig. 5A, D), rarely slit-like (Fig. 14D); receptacular cluster always racemose (never digitiform as in some *trang*-group species), moderately large, only in a few females slightly surpassing anterior margin of poreplate (e.g. Figs 5A-B, 18D, G-H). Poreplate and posterior stalk always fully sclerotised and connected to each other. The latter ranging from very short (e.g. Fig. 22K) to quite long (e.g. Fig. 9C and Aung *et al*., 2019: fig. 3B-E), and from much narrower than poreplate (e.g. Fig. 20) to distinctly wider than poreplate (e.g. Fig. 24D and Yu *et al*., 2021: fig. 4C-F), from widely eliptically (e.g. Fig. 9A) to quadrangular (e.g. Fig. 14B) and axe-blade-shaped (e.g. Fig. 16A), with a short and indistinct (e.g. Figs 22, 24) to long and pronounced (e.g. Fig. 20F-G) constriction in its anterior part.

Species included (n = 12): *Liphistius birmanicus* Thorell, 1897 (Myanmar), *L. cupreus* sp. nov. (Myanmar), *L. ferox* sp. nov. (Myanmar), *L. hpruso* Aung *et al*., 2019 (Myanmar), *L. lahu* Schwendinger, 1998 (Thailand), *L. lordae* Platnick & Sedgwick, 1984 (Myanmar), *L. metopiae* sp. nov. (Thailand), *L. nabang* Yu *et al*., 2021 (China), *L. pinlaung* Aung *et al*., 2019 (Myanmar), *L. platnicki* sp. nov. (Myanmar), *L. pyinoolwin* Xu *et al*., 2021 (Myanmar), *L. tung* sp. nov. (Myanmar).

Distribution: All species known so far occur in the mountainous area that lies roughly between the Ayeyarwady (= Irrawaddy) River in the west, the Mekong River in the east and the Thai-Burmese border in the south (Fig. 1). At least two of these species (*L. lahu* and *L. ferox* sp. nov.) occur together with or very close to species of the *bristowei*-group.

Key to the species:

1 Males (unknown for *L. hpruso*) 2
- Females..... 12
2(*1*) Proventral process of contrategulum strongly distad-directed, almost parallel to axis of palpal organ (Figs 13D, F, 15C) 3
- Proventral process of contrategulum inclined from axis of palpal organ at an angle of roughly 45-90° (Figs 4G, 6I, 8I, 10F, 17E, 19C, 21N, 23H) 4
3(*2*) Large spiders (CL and CW of males 7.79-9.30 and 7.29-8.48, respectively); paracymbium without retrolateral-proximal heel (Fig. 13H) ..... *L. birmanicus* (Myanmar)
- Medium-sized spiders (CL and CW of males 4.92-6.27 and 4.56-5.40, respectively); paracymbium with retrolateral-proximal heel (Fig. 15G) ..... *L. pinlaung* (Myanmar)
4(*2*) Para-embolic plate much longer than retroventral edge of embolus complex (Figs 8A, H-I, 10A-D 5
- Para-embolic plate as long as or only slightly longer than retroventral edge of embolus complex (Figs 4D, 6F, 13E, 15D, 17D, 19D, 21A, 23A) 6
5(*4*) Medium-sized spiders (CL and CW of males 6.30-6.70 and 5.70-6.26, respectively); sclerotised part of embolus proper strengthened by 3 longitudinal ribs reaching the apex, none of them with an angular distal protrusion (Fig. 8A, C-D, F-I); proximal edge of tegulum salient, distinctly protruding from surface of palpal organ (Fig. 8H-J); tibial apophysis distinctly set back from anterior margin of tibia (Fig. 8B) ..... *L. tung* sp. nov. (Thailand)
- Very large spiders (CL and CW of males 11.47-12.67 and 10.45-11.47, respectively); sclerotised part of embolus proper strengthened by only 2 longitudinal ribs reaching the apex, one of them carrying an angular distal protrusion (Fig. 10E-H); proximal edge of tegulum adpressed to surface of palpal organ (Fig. 10B); tibial apophysis only slightly set back from anterior margin of tibia (Fig. 10J) ..... *L. ferox* sp. nov. (Myanmar)
6(*4*) Cumulus distinctly elevated (Figs 21B, 23B, Yu *et al*., 2021: fig. 3D-F); paracymbium with distinctly conical distal side (21A, 23A, Yu *et al*., 2021: fig. 3D-F); proximal ledge on retrodorsal side of contrategulum indistinct or small (Figs 21E-F, H-I, L-N, 23F, H-I) 7
- Cumulus not or only slightly elevated (Figs 4H-J, 6J, L-N, 17G, 19E-F); paracymbium with indistinctly conical, almost plane distal side (Figs 4H-J, 6J, L-N, 17G, 19E-F); proximal ledge on retrodorsal side of contrategulum pronounced (Figs 4A-C, 6A-D, 17A, C, 19A) 9
7(*6*) Distal edge of contrategulum evenly rounded, without a prodorsal protrusion in distal view (Fig. 23E-F); distal margin of tegulum distinctly elevated, developed as a short and wide keel (Fig. 23I-M); paracymbium without a retrolateral-proximal heel (Fig. 23A) ..... *L. platnicki* sp. nov. (Myanmar)

- Distal edge of contrategulum with an angular or arched prodorsal protrusion in distal view (Fig. 21A, E-F, H-I, L, Yu *et al*., 2021: fig. 3B); distal margin of tegulum distinctly, indistinctly or not elevated (Fig. 21K, M, Yu *et al*., 2021: fig. 3A-B, D-E); paracymbium with or without a retrolateral-proximal heel (Yu *et al*., 2021: fig. 3E, Fig. 21A) 8

8(*7*) Distal edge of contrategulum with an angular prodorsal protrusion (Fig. 21A, E-F, H-I, L) and with a narrowly rounded dorsal apex (Fig. 21E-G); distal edge of tegulum not or only indistinctly elevated (Fig. 21K, M); paracymbium without a retrolateral-proximal heel (Fig. 21A) ..... *L. cupreus* sp. nov. (Myanmar)

- Distal edge of contrategulum with an arched prodorsal protrusion and with a pointed dorsal apex (Yu *et al*., 2021: fig. 3B); distal edge of tegulum distinctly elevated, developed as a short, wide keel (Yu *et al*., 2021: fig. 3A-B, D-E); paracymbium with a retrolateral-proximal heel (Yu *et al*., 2021: fig. 3E) ..... *L. nabang* (China)

9(*6*) Proventral process of contrategulum very wide, with widely truncate apex in distal view (Fig. 17A, C); heel of paracymbium protruding proximally (Fig. 17G) ..... *L. lordae* (Myanmar)

- Proventral process of contrategulum conical, with narrowly rounded or narrowly and obliquely truncate apex in distal view (Figs 4A-C, 6A-D, 19A); heel of paracymbium protruding retrolaterally (Figs 4H-J, 6J, L-N, 19E-F) 10

10(*9*) Retrolateral-proximal heel of paracymbium carrying 2-3 enlarged spicules (Fig. 19E-F); base of embolus complex with a lobate prolateral protrusion in distal view (Fig. 19A-B) ..... *L. pyinoolwin* (Myanmar)

- Retrolateral-proximal heel of paracymbium without enlarged spicules but normal spicules or stiff bristles instead (Fig. 4H-J, 6J, L-N); base of embolus complex without prolateral protrusion in distal view (Fig. 4C, 6A) 11

11(*10*) Depth/length ratio of tibial apophysis of palp ~ 1.4 (Fig. 4F); retrolateral-proximal heel of paracymbium widely rounded (Fig. 4H-J); prolateral part of distal edge of contrategulum indistinctly elevated (Fig. 4E, G); no invagination between para-embolic plate and retroventral edge of embolus complex (Fig. 4C-D) ... *L. lahu* (Thailand)

- Depth/length ratio of tibial apophysis of palp ~ 2.2 (Fig. 6O); retrolateral-proximal heel of paracymbium narrowly rounded (Fig. 6J, L-N); prolateral part of distal edge of contrategulum distinctly elevated (Fig. 6H-I); a shallow invagination between para-embolic plate and retroventral edge of embolus complex (Fig. 6F-H) ..... *L. metopiae* sp. nov. (Thailand)

12(*1*) Portions of carapace, legs and palps of females and of last immature instars of males orange-coloured (Fig. 3E-I) 13

- Body and legs uniformly dark, or body brown and legs more or less distinctly annulated (Figs 2, 3A-C) 14

13(*12*) Large spiders (CL and CW of females up to 14.73 and 13.27, respectively); posterior stalk of vulval plate usually wider than long or rarely as wide as long, its posterior margin usually straight, rarely widely rounded (Fig. 14) ..... *L. birmanicus* (Myanmar)

- Medium-sized spiders [CL and CW of female holotype (fully grown?) 7.02 and 6.16, respectively]; posterior stalk of vulval plate clearly longer than wide, its posterior margin narrowly rounded or angular (Aung *et al*., 2019: fig. 3B-E) ..... *L. hpruso* (Myanmar)

14(*12*) Very large spiders (CL and CW in females up to 18.32 and 16.61, respectively); anterior lobes of poreplate folded ventrad (Figs 11-12); body and legs uniformly very dark, without annulations (Fig. 3A-B) ..... *L. ferox* sp. nov. (Myanmar)

- Medium-sized spiders [CL and CW in females up to 8.50 and 7.90, respectively (for *L. lordae*)]; anterior lobes of poreplate not folded ventrad (Figs 5, 7, 9, 16A-J, 18, 20, 22, 24, Yu *et al*., 2021: fig. 4); body brown to dark, legs annulated or not 15

15(*14*) Posterior stalk as wide as or wider than poreplate; anterior lobes of poreplate reduced to 1-2 clusters of vesicles on each side (Figs 22, 24, Yu *et al*., 2021: fig. 4) 16

- Posterior stalk narrower than poreplate; anterior lobes of poreplate fully developed (Figs 5, 7, 9, 16A-J, 18, 20) 18

16(*15*) Ventral side of vulval plate with a widely separated pair of "bulging margins" laterally between poreplate and posterior stalk; posterior part of genital atrium strongly curved ventrad (Yu *et al*., 2021: fig. 4) ..... *L. nabang* (China)

- "Bulging margins" absent; posterior part of genital atrium not strongly curved ventrad 17

17(*16*) Anterior margin of poreplate with 1-2 rather small clusters of vesicles on each side; lateral margins of poreplate without anterolateral processes; posterior stalk much shorter than poreplate (Fig. 22); prefoveal setae on carapace absent ..... *L. cupreus* sp. nov. (Myanmar)

- Anterior margin of poreplate with only one rather large cluster of vesicles on each side; lateral margin of poreplate with a small knob-shaped anterolateral process on each side; posterior stalk almost as long as poreplate (Fig. 24); prefoveal setae present ..... *L. platnicki* sp. nov. (Myanmar)

18(*15*) No knob-shaped anterolateral processes on ventral side of poreplate (Figs 5, 9, 18) 19

- Each lateral side of poreplate ventrally with a knob-shaped anterolateral process (Figs 7, 16A-J, 20) 21

19(*18*) Anterior lobes of poreplate very wide and continuous with lateral poreplate margins, no step between them step (Fig. 18); no annulations on legs and palps ..... *L. lordae* (Myanmar)
- Anterior lobes of poreplate mostly rather narrow, with a more or less distinct step between them and lateral poreplate margins (Figs 5, 9); legs and palps with or without annulations 20

20(*19*) Step between anterior lobes and lateral margins of poreplate pronounced; length of posterior stalk clearly more than half of poreplate length (Fig. 9); legs and palps not annulated ..... *L. tung* sp. nov. (Myanmar)
- Step between anterior lobes and lateral margins of poreplate rather indistinct; length of posterior stalk less than or little more than half of poreplate length (Fig. 5); legs and palps annulated ..... *L. lahu* (Thailand)

21(*18*) Posterior stalk of vulval plate clearly longer than wide or only slightly wider than long, its anterior portion with a long constriction (Fig. 20; Xu *et al.*, 2021: figs 5-7) ..... *L. pyinoolwin* (Myanmar)
- Posterior stalk of vulval plate clearly wider than long, its anterior portion with a short constriction (Figs 7, 16A-J; Aung *et al.*, 2019: fig. 5) 22

22(*21*) Anterior margin of poreplate mostly with a deep and narrowly U-shaped invagination between anterior lobes (indistinct in Fig. 7E); posterior stalk of vulval plate small in comparison with poreplate (Fig. 7); legs and palps annulated ..... *L. metopiae* sp. nov. (Thailand)
- Anterior margin of poreplate with a less deep, more widely U-shaped or widely V-shaped invagination between anterior lobes; posterior stalk of vulval plate distinctly larger in comparison with poreplate (Fig. 16A-J, Aung *et al.*, 2019: fig. 5); legs and palps not annulated ..... *L. pinlaung* (Myanmar)

Detailed presentation of species:

Liphistius lahu Schwendinger, 1998

Figs 1, 4-5

Liphistius lahu Schwendinger, 1998: 17-19, fig. 1A-H (description of males and females). – Schwendinger, 1999: fig. 1A-H (reprint of illustrations in Schwendinger, 1998).

Holotype: MHNG-ARTO-0024737; male; Thailand, Chiang Mai Province, Fang District, Doi Angkhang, 1540 m, 19°55'10"N, 99°02'55"E; 27.VIII.1990; leg. P.J. Schwendinger.

Paratypes: MHNG-ARTO-0024739; 1 male; collected together with the holotype. – MHNG-ARTO-0024740 to 24745; 6 female paratypes; collected at the type locality; 27.VIII.1990 and 25.IX.1986; leg. P.J. Schwendinger.

Other material: MHNG; 1 female; Thailand, Chiang Mai Province, Fang District, Doi Pha Luang, 1600 m, 20°02'37"N, 99°06'14"E; 3.XI.1990; leg. P.J. Schwendinger. No new material available.

Diagnosis: Males distinguished by a moderately deep tibial apophysis (depth/length ratio ~ 1.4, Fig. 4F), by a widely rounded retrolateral-proximal heel on paracymbium (Fig. 4H-J), by an indistinctly elevated prolateral part of the distal contrategular edge (Fig. 4E, G), and by short para-embolic plate not separated by an invagination from retroventral edge of embolus complex (Fig. 4C-E). Females distinguished by ventral side of poreplate without anterolateral processes and by an indistinct step between anterior lobes and lateral poreplate margins; posterior stalk axe-blade-shaped, about half as long as poreplate (Fig. 5).

Additions to description: Medium-sized spiders with brown colouration in both sexes and annulated legs and palps in females and juveniles (in large spiders less distinct than in small ones, annulations thus fading as females become older and larger). Males with scopula weak on tarsi I-II, slightly denser on tarsi III-IV, covering distal 4/5 of tarsus I and distal 5/6 of tarsi II-IV. Male palps with moderately deep tibial apophysis (depth/length ratio ~ 1.4), not set back from distal margin of tibia, carrying four long, pointed apical megaspines (Fig. 4F; Schwendinger, 1998: fig. 1A-C; Schwendinger, 1999: fig. 1A-C); paracymbium short, with an almost flat distal surface and with a widely arched retrolateral-proximal heel (Fig. 4H-J); cumulus indistinct, carrying a group of 5-6 long, strong bristles (Fig. 4H-J; Schwendinger, 1998: fig. 1B-C; Schwendinger, 1999: fig. 1B-C); subtegulum without apophysis (Fig. 4E); proventral process of contrategulum conical, with narrowly rounded apex in dorsal view (Fig. 4A-C); prolateral part of distal edge of contrategulum developed as a low (not elevated as in *L. metopiae* sp. nov.) keel (Fig. 4E, G); no wrinkles on dorsal side of contrategulum, a pronounced proximal ledge on its retrodorsal side (Fig. 4A-C); distal edge of contrategulum very wide, with narrowly rounded dorsal apex (Fig. 4A-C; Schwendinger, 1998: fig. 1D-E; Schwendinger, 1999: fig. 1D-E); tegulum large, its distal margin not elevated, its proximal edge widely arched, coarsely serrate, bent and distinctly overhanging membranous area of contrategulum below it (Fig. 4C-D; Schwendinger, 1998: fig. 1A-B; Schwendinger, 1999: fig. 1A-B); para-embolic plate very short, not separated from retroventral edge of embolus complex by an invagination (Fig. 4C-E); sclerotised part of embolus proper strengthened by 3-4 distally dentate longitudinal ribs reaching apex, narrowly divided from distinctly shorter membranous embolus part; at base of membranous embolus part a weakly pigmented area with only 3-4 longitudinal wrinkles and with a wide and

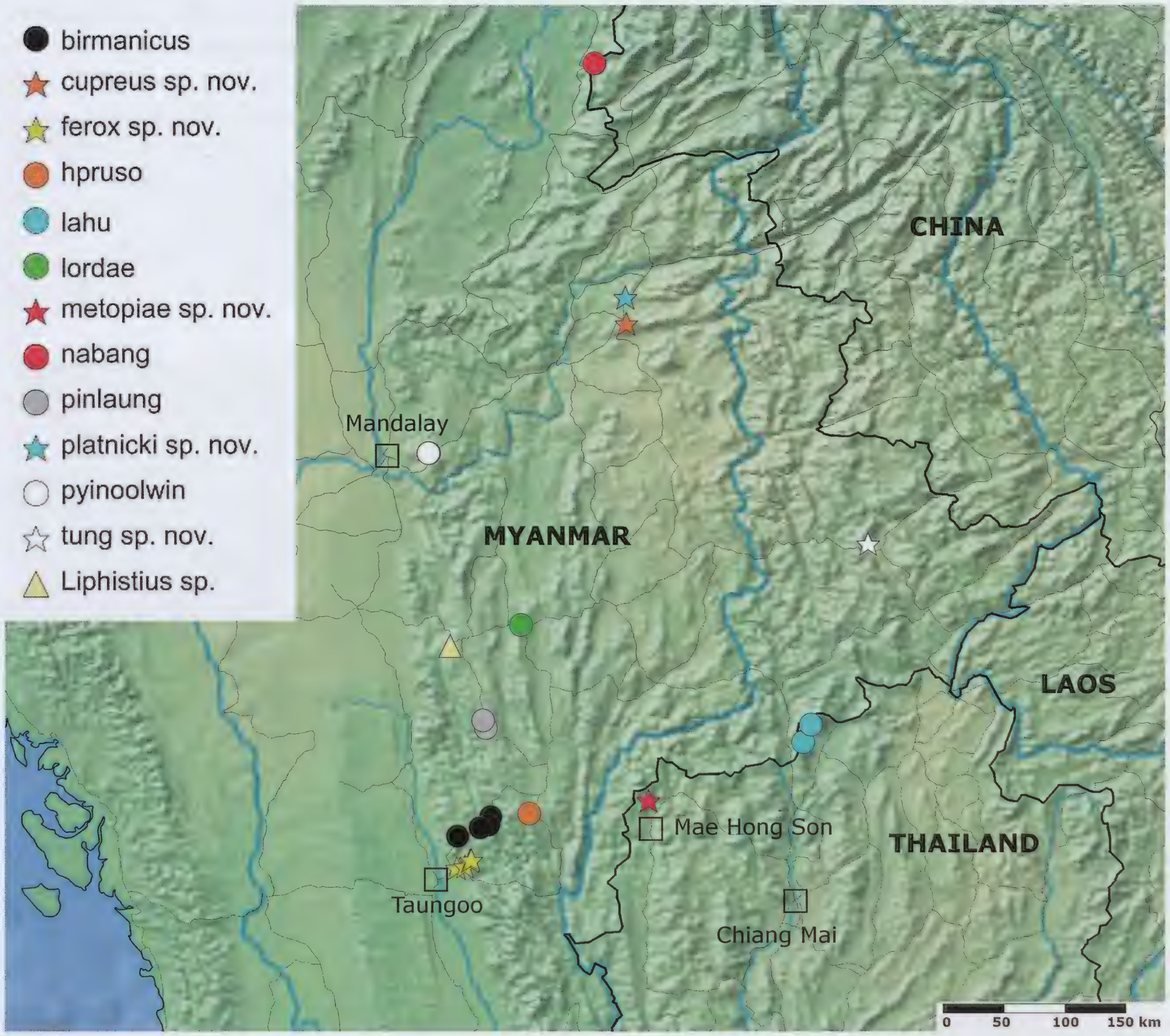


Fig. 1. Localities of species in the *Liphistius birmanicus*-group in northern Thailand, eastern Myanmar and southern China. Blue lines indicate major rivers, black lines national borders, grey lines major roads.

asymmetrical distal margin (Fig. 4C-D, G). Females with more or less distinctly annulated legs and palps; uterus externus with a small pair of lateral pockets (as illustrated for *L. ferox* sp. nov., Fig. 11I-J, N, P and Fig 12D, F); vulval plate with several hairs on lateral folds; poreplate wider than long, with a pair of pronounced, rounded lobes on anterior margin, without anterolateral processes; an indistinct step between anterior lobes and lateral poreplate margins (Fig. 5E-F, H); receptacular cluster racemose, quite long, almost reaching or slightly surpassing anterior margin of poreplate (Fig. 5; Schwendinger, 1998: fig. 1F-H; Schwendinger, 1999: fig. 1F-H); posterior stalk axe-blade-shaped, its anterior portion narrow, its posterior margin wide and arched, narrower than poreplate.

Variation: For carapace measurements and prefoveal setae counts see Table 1. All specimens examined have well-developed AME. Variation in the shape of the paracymbium and of the distal edge plus the proventral process of the contrategulum of males is shown in Fig. 4H-J and Fig. 4A-C, respectively. Variation in the shape of the vulval plates of five females is shown in Fig. 5.

Relationships: Palp morphology of males is very similar in *L. lahu* and *L. metopiae* sp. nov., indicating that these two species are not only geographically but also phylogenetically close to each other.

Distribution: *Liphistius lahu* is known from two localities in the mountains of the northern Thai province of Chiang Mai, at and close to the border with the Shan State of Myanmar (Fig. 1). This species can probably be found on both sides of that border.

Biology: Information is given in the original description (Schwendinger, 1998: 19). No new specimens or new biological information are available.

Liphistius metopiae Schwendinger, sp. nov.

Figs 1, 6-7

Liphistius sp.: Schwendinger & Pape, 2000: 353, figs 4-5 (report on predation by fly).

Holotype: MHNG-ARTO-0028249; male (matured 17.VII.1998; right tarsus IV, and to a lesser extent also right tarsus III, bent due to deformation in final moult); Thailand, Mae Hong Son Province and District, near Pang Tong Palace (19°30'10"N, 97°56'56"E), 870 m; 27.XII.1997; leg. P.J. Schwendinger.

Paratypes: MHNG-ARTO-0028250; 1 male (matured 7.VII.1998); collected together with the holotype. – MHNG-ARTO-0028251, MHNG-ARTO-0028265, MHNG-ARTO-0028266; 3 females (allotype, MHNG-ARTO-0028251); same locality; 2.XII.1998; leg. P.J. Schwendinger. – MHNG-ARTO-28252; 1 female; same locality; 21.X.2000; leg. P.J. Schwendinger. – THNHM; 1 female; same locality; 21.X.2000; leg. P.J. Schwendinger.

Etymology: The species epithet is a name in the genitive case referring to the sarcophagid fly *Metopia*

Fig. 2. Habitus of some species of the *Liphistius birmanicus*-group. (A) *Liphistius tung* sp. nov., male holotype. (B) *Liphistius pyinool-win*, male (matured 1.X.2014) from the Anisakan Falls; note exuviae of ectoparasitic mites (*Ljunghia* sp.) on the opisthosoma. (C) *Liphistius platnicki* sp. nov., female paratype (moulted 10.III.2021) from near Loi Kan Village. (D, F) *Liphistius cupreus* sp. nov., male paratype from near Kong Nyaung Village. (E) Same species, different male paratype. (G) Same species, female paratype (moulted 13.II.2021). (H-I) Same species, different female paratype (moulted 21.V.2021). Not to scale.

sinensis Pape, 1986 whose larvae were observed devouring a female of the new species (Schwendinger & Pape, 2000).

Diagnosis: Medium-sized species with annulated legs and palps in females and juveniles. Similar to *L. lahu*, males distinguished by a relatively deeper tibial apophysis (depth/length ratio ~ 2.2 versus ~ 1.4 in *L. lahu*; Fig. 6O cf. Fig. 4F), by a more pronounced retrolateral-proximal heel on paracymbium (Fig. 6J, L-N cf. Fig. 4H-J), by prolateral part of distal edge of the contrategulum more distinctly elevated (indistinctly elevated in *L. lahu*; Fig. 6H-I cf. Fig. 4E, G), and by short para-embolic plate and retroventral edge of embolus complex separated by a very shallow invagination (Fig. 6F-H; no invagination in *L. lahu*, Fig. 4C-E). Females distinguished from those of *L. lahu* by ventral side of poreplates carrying distinct anterolateral processes and by a smaller receptacular cluster (Fig. 7 cf. Fig. 5).

Fig. 3. Habitus of some species of the *Liphistius birmanicus*-group. (A) *Liphistius ferox* sp. nov., male paratype (matured 1.IX.2014) from Pathi Village. (B) Same species, female paratype from Thandaung Gyi. (C) *Liphistius pinlaung*, female from near Tong Htiwaw Temple. (D) *Liphistius birmanicus* from Yado, male (matured 20.IX.2017). (E) Same species, large female n°1. (F, H) Same species, large female n°2. (G) Same species, small female. (I) Same species, large female n°3. Not to scale.

Description of male (holotype): *Colour in alcohol* (darker in life): Mostly light brown, with some lighter spots on patellae and tibiae of legs and palps (remnants of median and distal annulation). Some light spots also on opisthosomal tergites III-X; on tergites VI-VII most of median portion very light, with only a few dark spots. Most of ventral surface of leg femora and of palpal tibia very light. Palpal tarsus, sclerites of palpal organ and cheliceral fangs dark reddish brown. Most of ventral side of palpal coxae and proximal portion of proximal cheliceral article cream-coloured. Opisthosomal membranes very light brown, speckled with dark brown. Eye mound very dark.

Setae on carapace: A few setae remote from margin; none anterior to fovea.

Cheliceral teeth: 12 and 13 (including a tiny one) small teeth of different sizes on promargin of right and left cheliceral groove, respectively.

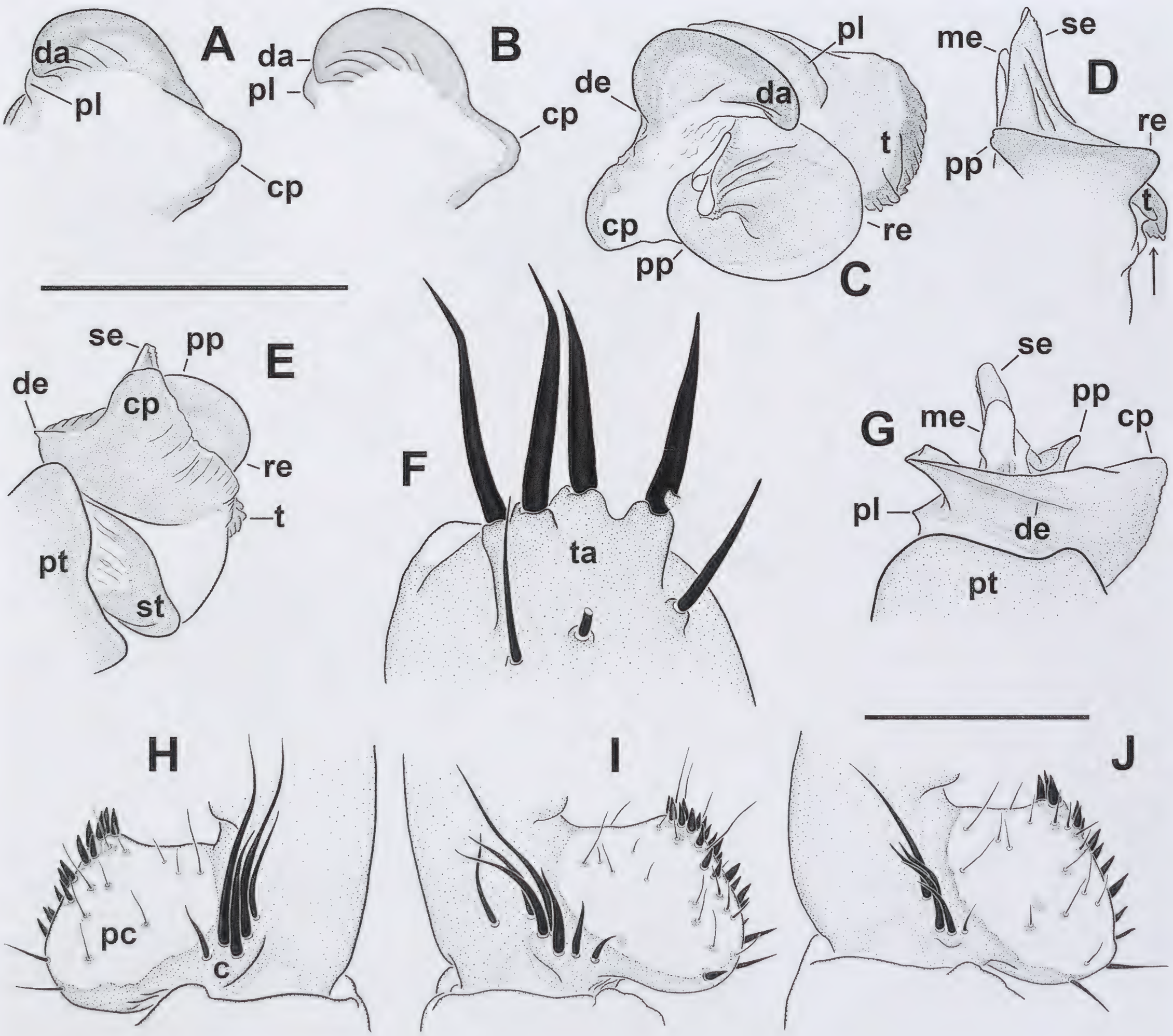


Fig. 4. *Liphistius lahu*, palp of male holotype (B-I) and of male paratype (A, J). (A-B) Contrategulum of right palp, distal view (dorsal side up). (C) Left palpal organ, distal and slightly retrodorsal view (dorsal side up). (D) Distal part of left palpal organ, retroventral and slightly distal view; bent proximal edge of tegulum indicated by arrow. (E) Distal part of left palp, ventral and slightly proximal view. (F) Distal part of left tibia, retrolateral and slightly proximal view. (G) Palpal organ and distal margin of tibia of left palp, prolateral and slightly proximal view. (H) Proximal part of tarsus of right palp, ventral view. (I-J) Same of left palp. Scale lines 1.0 mm (A-G; H-J). Abbreviations: c - cumulus; cp - proventral contrategular process; da - dorsal apex of distal contrategular edge; de - prolateral part of distal edge of contrategulum; me - membranous part of embolus proper; pc - paracymbium; pl - proximal ledge on retrodorsal side of contrategulum; pp - para-embolic plate; pt - palpal tarsus; re - retroventral edge of embolus complex; se - sclerotised part of embolus proper; st - subtegulum; t - tegulum; ta - tibial apophysis.

Scopula: Distally divided by a short glabrous longitudinal stripe and proximally with a median row of stiff bristles on all tarsi; quite thin and not clearly outlined in distal 3/4 of ventral side of leg tarsi I-II; dense and clearly outlined, covering 4/5 of ventral side of tarsi III-IV.
Tarsal claws: Paired claws with 3-4 teeth on tarsus I, 4 teeth on tarsi II-III, 4-5 teeth on tarsus IV; unpaired claw of tarsi II-III with 0-1 denticle, of tarsi I and IV without denticle.
Palp: Tibial apophysis basally wide in ventral view (Fig. 6K) and deep in retrolateral view (depth/length ratio ~ 2.2, Fig. 6O), not set back from distal margin of tibia (Fig. 6K), carrying four apical megaspines with tapering tips, the ventral two longer than the dorsal two (Fig. 6K, O). Distal margin of tarsus widely but shallowly invaginated (Fig. 6I). Paracymbium short, wider than long in ventral view, moderately deep, with an almost flat distal surface and a pronounced, narrowly arched retrolateral-proximal heel (Fig. 6J, M); indistinctly elevated cumulus carrying a group of 4-5 long strong bristles (Fig. 6J, M). Subtegulum with an indistinct apophysis (Fig. 6J, see also Fig. 6L for paratype). Tegulum wide, with long and strongly bent, coarsely serrate proximal edge and with a long transverse median ridge; distal margin not elevated (Fig. 6E-F). Pigmented bridge between tegulum and contrategulum on retrodorsal side of palpal organ narrow (Fig. 6E). Contrategulum with short, quite wide proventral process ending in a narrow, truncate apex (Fig.

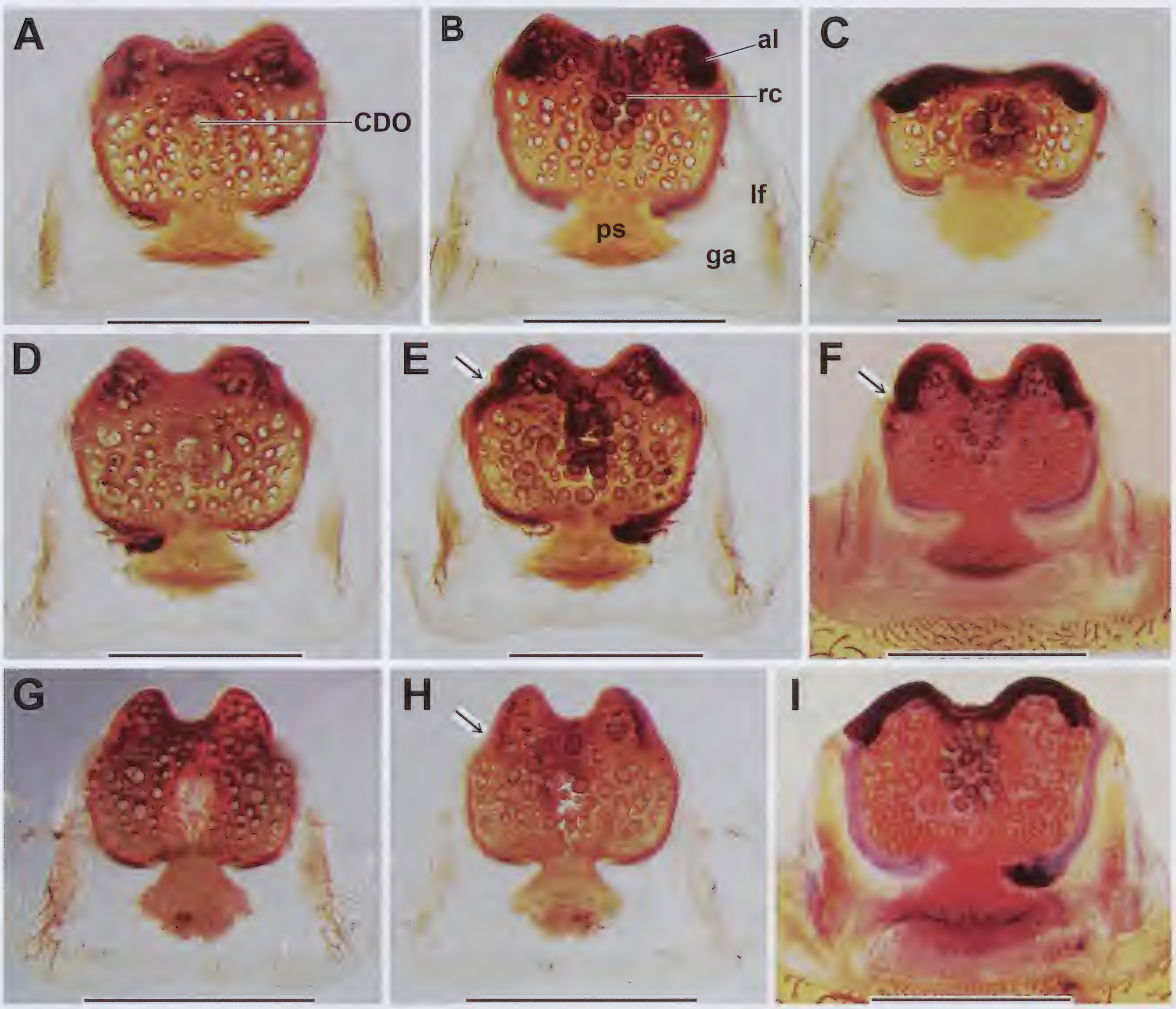
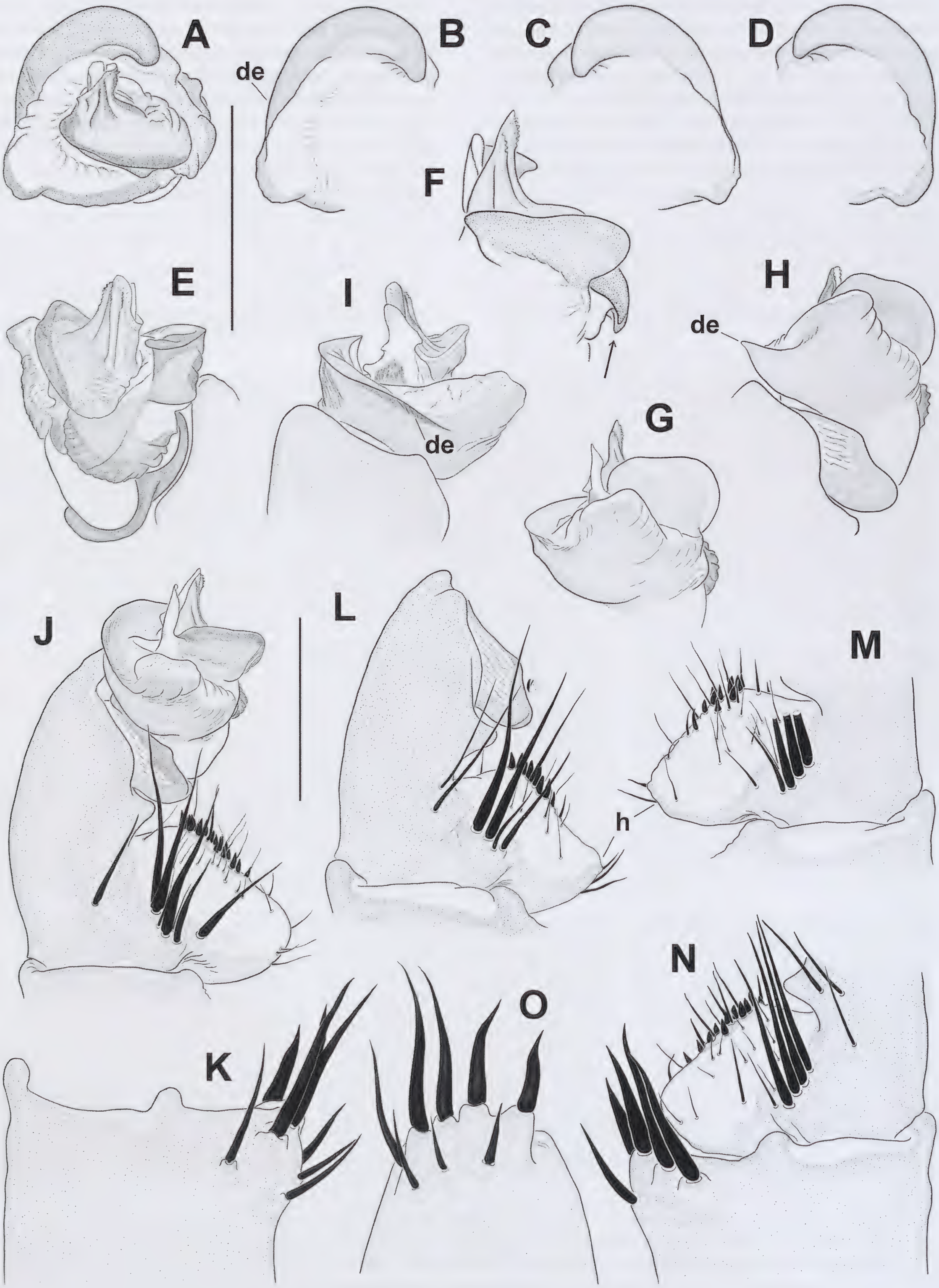


Fig. 5. *Liphistius lahu*, vulval plates of five females; dorsal view (A, D, G), ventral view (B, E-F, H-I) and anteroventral view (C). (A-C) Paratype MHNG-ARTO-0024744 (taken from specimen). (D-E) Paratype MHNG-ARTO-0024741 (from exuvia). (F) Paratype MHNG-ARTO-0024745 (from specimen). (G-H) Paratype MHNG-ARTO-0024742 (from exuvia). (I) Female from Doi Pa Luang (from specimen). Scale lines 1.0 mm. Arrows indicating indistinct step between anterior lobes and lateral margin of poreplate. Abbreviations: al - anterior lobe of poreplate; CDO - central dorsal opening of poreplate; ga - genital atrium; lf - lateral fold of vulval plate; ps - posterior stalk; rc - receptacular cluster.


A
B
de
C
D
F
E
I
de
H
de
G
J
L
M
h
N
K
O

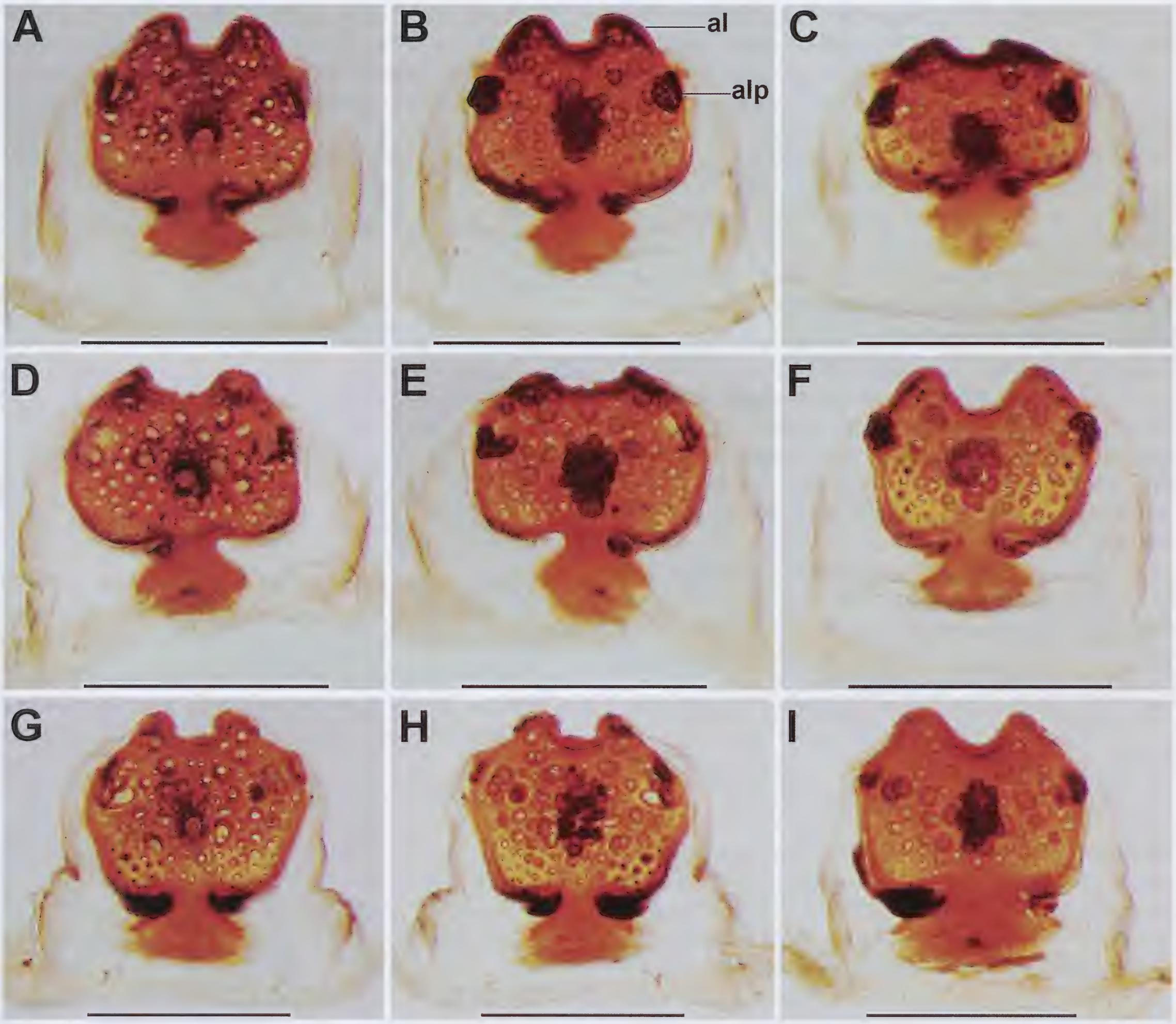


Fig. 7. *Liphistius metopiae* sp. nov., vulval plates of five female paratypes (all taken from exuviae); dorsal view (A, D, G), ventral view (B, E-F, H-I) and anteroventral view (C). (A-C) Allotype; moult of 23.IV.1998. (D-E) Moult of 16.IV.1999. (E) Moult of 24.II.2000. (G-H) Moult of 28.VI.2001. (I) Moult of 4.III.1999. Scale lines 1.0 mm. Abbreviations: al - anterior lobe of poreplate; alp - anterolateral process of poreplate.

Fig. 6. *Liphistius metopiae* sp. nov., palps of male holotype (A, D-K, M, O) and of male paratype (B-C, L, N). (A) Left palpal organ, distal view (dorsal side up). (B) Distal edge of contrategulum and proventral process of left palp, distal view. (C-D) Same of right palp, distal view. (E) Left palpal organ, retrolateral view. (F) Distal part of left palpal organ, retroventral and slightly distal view; bent proximal edge of tegulum indicated by arrow. (G) Same, ventral and slightly proximal view. (H) Entire palpal organ and distal margin of tibia, ventral and more proximal view than in G. (I) Same, prolateral view. (J) Left tarsus and palpal organ, ventral view. (K) Distal part of left tibia, ventral view. (L) Left tarsus and subtegulum, ventral view. (M) Right paracymbium, ventral view. (N) Right paracymbium and distal part of tibia, ventral view. (O) Distal part of tibia, retrolateral and slightly proximal view. Scale line 1.0 mm (A-I; J-O). Abbreviations: de - prolateral part of distal contrategular edge; h - retrolateral-proximal heel of paracymbium.

◄

6A, D); with several wrinkles on dorsal surface (Fig. 6I) and with a distinct proximal ledge on retrodorsal side (Fig. 6A, D); distal edge of contrategulum quite wide and widely arched, its prolateral part distinctly elevated into a keel (Fig. 6H-I), its dorsal apex narrowly rounded (Fig. 6A, D). Para-embolic plate short and widely arched, separated from keel-shaped retroventral edge of embolus complex by an indistinct invagination (Fig. 6F-H). Embolus proper with sclerotised part strengthened by 3-4 longitudinal ribs reaching apex and carrying tiny denticles distally (Fig. 6A, E-J); membranous part of embolus proper distinctly shorter than sclerotised part, both narrowly divided; at base of membranous embolus part a short weakly pigmented area with numerous (distinctly more than in *L. lahu*) longitudinal wrinkles and with a widely and asymmetrically angular distal margin (Fig. 6I); embolic folds (connecting membranous and sclerotised parts of embolus proper) short and indistinct (Fig. 6A, I).

Measurements: Total length 14.68; CL 6.03, CW 5.44; opisthosoma 6.27 long, 3.89 wide; eye mound 0.81 long, 1.01 wide; palpal coxa 1.90 long, 1.35 wide; labium 0.60 long, 1.15 wide; sternum 2.90 long, 1.75 wide (0.95 on ventral surface); palp 10.60 long (3.17 + 1.83 + 3.77 + 1.83); leg I 17.73 long (5.00 + 2.38 + 3.81 + 4.40 + 2.14); leg II 19.13 long (5.16 + 2.38 + 3.97 + 5.16 + 2.46); leg III 20.76 long (5.24 + 2.42 + 4.21 + 6.19 + 2.70); leg IV 27.47 long (6.55 + 2.66 + 5.56 + 8.89 + 3.81).

Description of female (allotype): *Colour in alcohol* (distinctly darker in life): Mostly light brown. Eye mound very dark. Chelicerae brown distally, cream-coloured proximally. Carapace with dark pattern including torch-shaped marking between eye mound and fovea. Palpal coxae only slightly lighter than leg coxae (in contrast to males); labium and sternum distinctly lighter than leg coxae. Legs light brown, with indistinct dark annulations proximally and subdistally on tibiae of legs and palps; tarsi I-II uniformly brown, tarsi III-IV with a light median zone. Membranous cuticle of opisthosoma light greyish brown with dark spots; tergites I-II uniformly brown, the following tergites with increasingly larger light areas, on tergites V-X brown areas reduced to lateral marks.

Setae on carapace: Few (only slightly more than in males) short, blunt setae on posterior and lateral margins and on coxal elevations of carapace; 10 setae in two parallel rows anterior to fovea.

Cheliceral teeth: 12 strong teeth on promargin of each cheliceral groove.

Claws: Palpal claws with 2 and 4 indistinct denticles. Paired tarsal claws of all legs with 3 teeth; unpaired claws of legs I-II with 1 denticle, none on legs III-IV (left tarsus IV missing). All tarsi without scopula.

Vulva (Fig. 7A-C): Uterus externus not examined; presumably small lateral pockets present. Vulval plate slightly wider than long, its lateral folds well developed, carrying several hairs. Anterior margin of poreplate with a quite large pair of arched lobes separated by a deep U-shaped invagination; lateral margins of poreplate ventrally with a knob-shaped anterolateral process on each side; posterior margins of poreplate distinctly bulged; CDO moderately developed, situated slightly posterior to centre of poreplate; receptacular cluster racemose, longer than wide, not reaching anterior margin of poreplate. Posterior stalk relatively short, axe-blade-shaped, clearly narrower than poreplate.

Measurements: Total length 20.99; CL 7.82, CW 6.73; opisthosoma 9.41 long, 7.82 wide; eye mound 1.04 long, 1.23 wide; palpal coxa 2.67 long, 1.78 wide; labium 0.89 long, 1.88 wide; sternum 3.86 long, 2.38 wide (1.48 on ventral surface); palp 12.83 long (4.16 + 2.38 + 3.22 + 3.07); leg I 15.54 long (4.75 + 2.67 + 3.27 + 3.27 + 1.58); leg II 16.48 long (5.05 + 2.77 + 3.37 + 3.61 + 1.68); leg III 18.02 long (5.10 + 2.92 + 3.56 + 4.36 + 2.08); leg IV 24.70 long (6.63 + 3.27 + 4.90 + 7.13 + 2.77).

Variation: For carapace measurements and prefoveal setae counts see Table 1. In all specimens examined the AME are well developed. In both males examined extent and density of the scopulae are the same. Variation in the shape of the dorsal apex of the distal contrategular edge and of the proventral contrategular process is shown in Fig. 6A-D; variation in the shape of the paracymbium in Fig. 6J, L-N. The male paratype has two long transverse median ridges on the tegulum, the holotype has only one (Fig. 6E). The holotype has one of the ventral bristles on the palpal tarsus distinctly stronger than the other bristles there (Fig. 6J); in the paratype two of these bristles are strengthened (Fig. 6L). The pigmented area at the base of the membranous part of the embolus has either a widely and obliquely truncate distal margin, giving the area an upside-down panflute-like shape, or its distal margin is widely and obliquely angular, like an asymmetrical roof (Fig. 6I). Females have more or less distinctly annulated legs and palps. In two of the females the dark pattern on the pars cephalica of the carapace is less distinct than in the other three females examined. Variation in the shape of the vulval plate is shown in Fig. 7. Intraspecific variation in the shape of the vulval plates (particularly concerning anterior lobes and posterior stalk) is considerable, but all females examined possess distinct anterolateral processes, which clearly distinguish them from females of the closely related *L. lahu*.

Relationships: *Liphistius metopiae* sp. nov. is morphologically similar and geographically close to *L. lahu*, which occurs about 130 km to the northeast (Fig. 1). Looking only at male genital characters, both species are difficult to distinguish, but the differences in female genital characters are more obvious. Both species appear to be most closely related to each other.

Distribution: The new species is only known from

its type locality in Mae Hong Son Province, northern Thailand (Fig. 1). Since this is only 6-7 km away from the Thailand-Myanmar border, it is quite likely that *L. metopiae* sp. nov. also occurs in Myanmar.

Biology: Most small burrows (inhabited by juveniles) are T-shaped and equipped with two trapdoors; most large burrows are simple and have only one trapdoor. The largest door (of a female; n=7) observed in the field was 2.2 cm long and 3.2 cm wide; the front doors of the two males examined were 1.2-1.4 cm long and 1.8-2.0 cm wide. In the field many doors had moss growing on them. There were up to eight signal lines attached to the front entrance of the burrows; the longest line measured 6.5 cm. Four fresh egg cases, 2.1-2.8 cm long, 2.1-3.2 cm wide, 1.4-2.0 cm high, were collected in early and late December; an additional egg case (2.8, 3.0, 2.0 cm respectively) was constructed in captivity in early January. The cases contained 80, 113, 180, 210, 231 and 231 eggs suspended on a fine sheet of thin silken treads. In captivity the two males examined matured in early and late July, about half a year after being collected. In early December several females had egg cases in their burrows in the field. Females moulted between February and June.

Three females have pitlike bitemarks on the carapace and on the proximal part of the chelicerae. These were most likely caused by parasitic mites of the genus *Ljunghia* Oudemans, 1932 (see Halliday & Juvara-Bals, 2016).

Sarcophagid flies of the species *Metopia sinensis* raised from *L. lahu* carcasses in burrows at the type locality were initially interpreted as a case of carrion feeding (Schwendinger, 1998: 19). Later Schwendinger & Pape (2000) reported about empty puparia in burrows of *L. metopiae* sp. nov. (then already recognized as being different from *L. lahu*) and about six *M. sinensis* larvae that were slowly devouring a fully active female at the Pang Tong site. This predatory interaction between *Liphistius* and *M. sinensis* appears to be a rather widespread (but not common) phenomenon in northern Thailand. Circumstantial evidence indicates that larvae of this fly also feed on *L. bristowei* (Bristowe, 1976: 5; Schwendinger, 1990: 339; Schwendinger & Pape, 2000: 355). To our knowledge, this has not been observed for other *Liphistius* species.

Liphistius tung Schwendinger, sp. nov.

Figs 1, 2A, 8-9

Holotype: MHNG-ARTO-0028284 (sample THMY-10/08); male (matured 23.I.2014); Myanmar, Shan State, near Kong Paek Village (21°19'55"N, 99°30'37"E), NW of Kyaing Tong (= Kengtung, Keng Tong, Chieng Tung, Chiang Tung), 1300 m; 7.-8.I.2011; leg. P.J. Schwendinger.

Paratypes: MHNG-ARTO-0028285 (sample THMY-10/08); 1 male (matured 10.I.2013); collected together with the holotype. – MHNG-ARTO-0028286 to ARTO-28290, BRCM (sample THMY-10/08); 6 females (allotype, MHNG-ARTO-0028286); collected together with the holotype.

Other material: MHNG (sample THMY-10/08); 1 penultimate male collected together with the types.

Etymology: The species epithet is a name in apposition taken from "Tungkalasi", a mythical hermit who is said to have founded the city of Kengtung, the capital of a former Shan principality.

Diagnosis: Medium-sized species with no annulations on legs and palps in either sex. Similar to *L. lahu*, males distinguished by para-embolic plate much longer (Fig. 8H-I, cf. Fig. 4D); slightly bent proximal edge of tegulum more strongly salient (Fig. 8H-I cf. Fig. 4D); paracymbium without retrolateral-proximal heel, rectangular in ventral view (Fig. 8A-B cf. Fig. 4H-J). Females distinguished from those of *L. lahu* by lacking dark rings (annulations) on legs and palps and by vulval plates having a relatively longer posterior stalk, a larger CDO, a relatively shorter receptacular cluster, and anterior lobes closer to each other (Fig. 9 cf. Fig. 5).

Description of male (holotype): *Colour in alcohol* (see Fig. 2A): Mostly uniformly brown; ventral side of body slightly lighter than dorsal side; palpal coxae cream-coloured; proximal part of chelicerae and membranous cuticle of opisthosoma equally cream-coloured; opisthosomal tergites III-VI with indistinct light marks in centre of each lateral half; legs and palps without annulations; palpal tarsus and sclerites of palpal organ dark brown; eye mound very dark.

Setae on carapace: In posterior half distinctly more short, blunt-tipped setae than in anterior half; 4+5 setae in two parallel rows anterior to fovea.

Cheliceral teeth: 11 and 12 small teeth of different sizes on promargin of left and right cheliceral groove, respectively.

Scopula: Distally divided by a short glabrous longitudinal stripe and proximally with a median row of stiff bristles on all tarsi; quite thin and not clearly outlined in distal 2/3 of ventral side of leg tarsus I; equally developed and covering distal 3/4 of tarsus II; dense and clearly outlined, covering 4/5 of tarsi III-IV.

Tarsal claws: Paired claws with 4-5 teeth on tarsi I-II, 4-6 teeth on tarsus III, 5 teeth on tarsus IV; unpaired claw of tarsi I-II with 3-4 denticles, of tarsus III with 3 denticles, of tarsus IV with 1 denticle.

Palp: Tibial apophysis basally quite narrow in ventral view, distinctly set back from distal margin of tibia (Fig. 8B), carrying 4 long and tapering apical megaspines, the ventral two weaker and longer than the two dorsal ones (Fig. 8B). Distal margin of tarsus widely but shallowly invaginated (Fig. 8J). Paracymbium relatively short and moderately deep, quadrangular, longer than wide in ventral view, its distal side domed (not conical), without a retrolateral-proximal heel (Fig. 8A-B); slightly

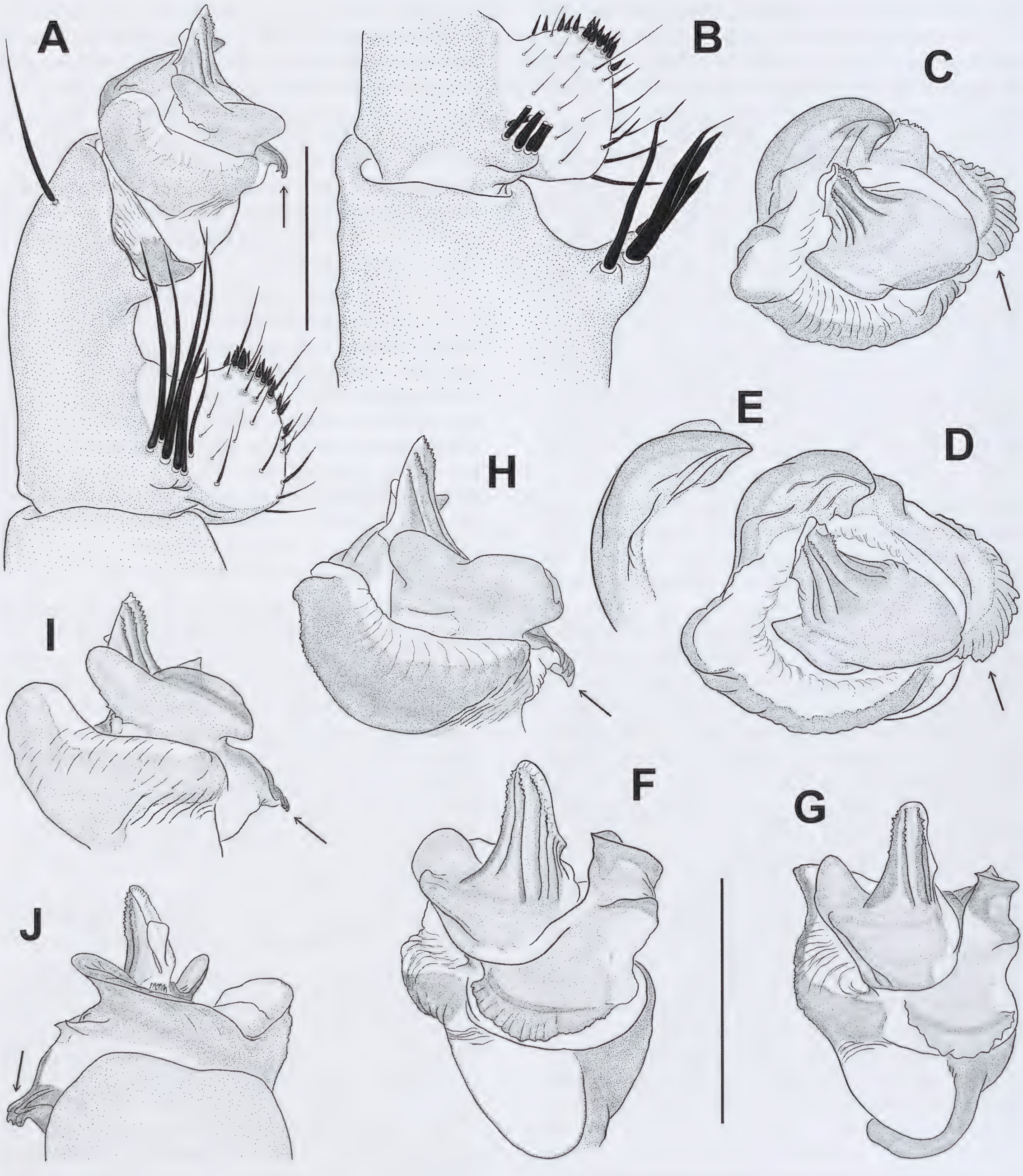


Fig. 8. *Liphistius tung* sp. nov., left palps of male holotype (A-C, G, I-J) and of male paratype (D-F, H). (A) Tarsus and palpal organ, ventral view. (B) Distal part of tibia and proximal part of tarsus, ventral view. (C-D) Palpal organ, distal view (dorsal side up). (E) Distal edge of contrategulum, distal and slightly prodorsal view. (F) Palpal organ, retrolateral view. (G) Same, retroventral view. (H-I) Distal part of palpal organ, ventral and slightly proximal view. (J) Distal part of tarsus and palpal organ, prolateral view. Arrows indicating bent and salient proximal edge of tegulum. Scale lines 1.0 mm (A-B; C-J).

elevated cumulus carrying a densely packed group of 5 long strong bristles (Fig. 8A-B). Subtegulum without apophysis (Fig. 8A, G). Tegulum wide, with long and slightly bent, moderately serrate proximal edge strongly protruding from surface of palpal organ (Fig. 8A, C, I-J); distal margin not elevated (Fig. 8G). Tegulum and contrategulum connected by a well-developed pigmented bridge on retrodorsal side of palpal organ (Fig. 8G). Contrategulum with short, blunt conical proventral process (Fig. 8C); no wrinkles on dorsal surface, a distinctly developed proximal ledge on retrodorsal side (Fig. 8C, G, J); distal edge of contrategulum widely arched and carrying pronounced ridges, its dorsal apex narrowly rounded (Fig. 8C), appearing pointed when slightly inclined prodorsad (Fig. 8E, showing male paratype). Para-embolic plate long, tounge-shaped, inclinded prodorsad, with rounded distal margin, its prodorsal margin weakly dentate (Fig. 8A, I). Retroventral edge of embolus complex distinctly elevated into a short, widely arched keel (Fig. 8I). Sclerotised part of embolus proper strengthened by 4 longitudinal ribs reaching apex and carrying denticles distally (Fig. 8A, C, G, I); membranous part of embolus proper distinctly shorter than sclerotised part, both narrowly divided; at base of membranous embolus part a short and weakly pigmented area with numerous longitudinal wrinkles, its distal margin horizontal and fairly straight (Fig. 8J); embolic folds short and indistinct.

Measurements: Total length 16.35; CL 6.30, CW 5.70; opisthosoma 7.18 long, 5.26 wide; eye mound 0.90 long, 1.21 wide; palpal coxa 2.23 long, 1.36 wide; labium 0.64 long, 1.32 wide; sternum 2.87 long, 2.15 wide (1.16 on ventral surface); palp 11.72 long (3.43 + 2.07 + 3.99 + 2.23); leg I 19.06 long (5.42 + 2.63 + 4.23 + 4.47 + 2.31); leg II 20.41 long (5.54 + 2.71 + 4.43 + 5.18 + 2.55); leg III 23.64 long (6.06 + 2.71 + 4.78 + 6.86 + 3.23); leg IV 29.31 long (6.90 + 2.79 + 5.90 + 9.33 + 4.39).

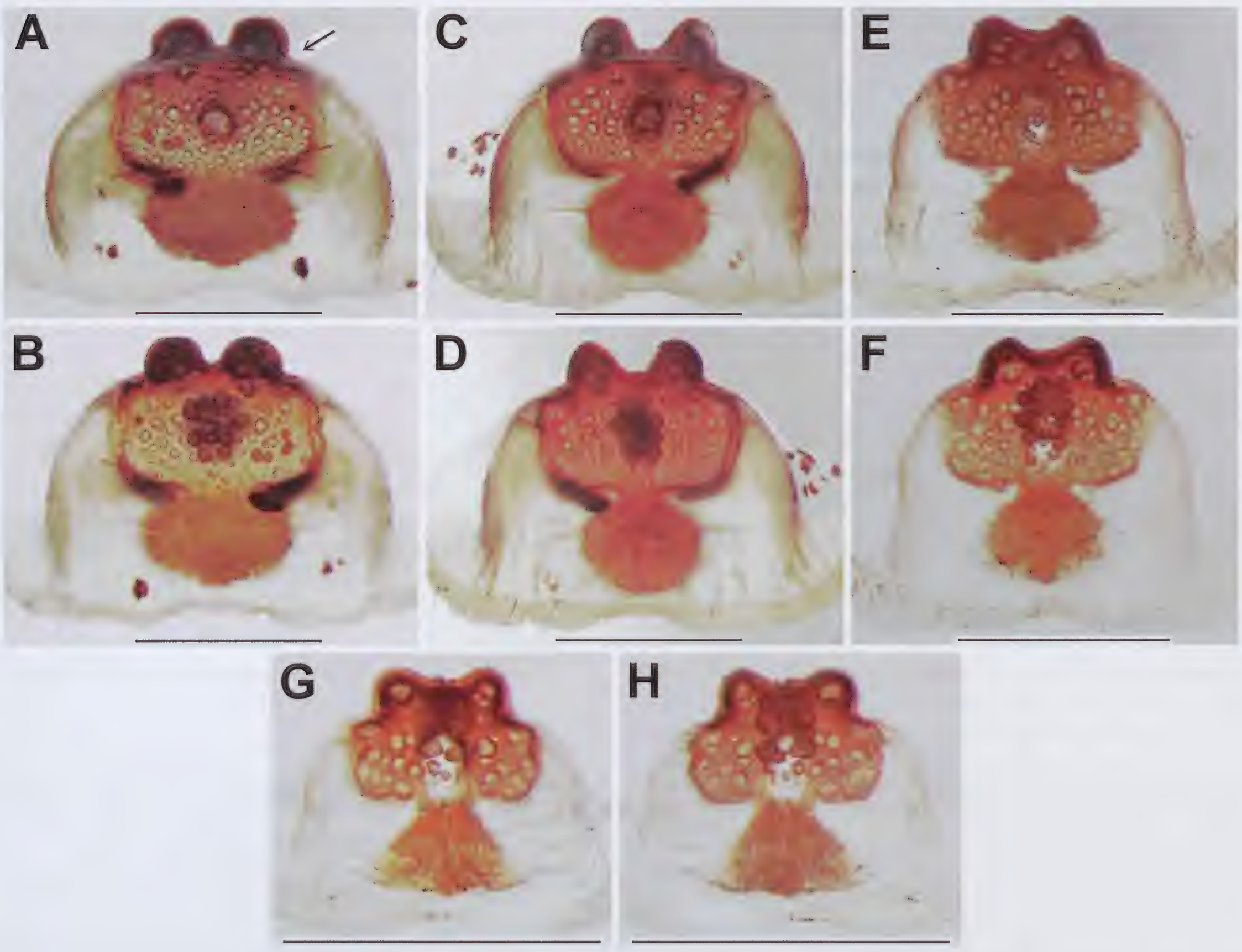


Fig. 9. *Liphistius tung* sp. nov., vulval plates of four females; dorsal view (A, C, E, G) and ventral view (B, D, F, H). (A-B) Allotype (taken from specimen). (C-D) Large paratype (taken from specimen). (E-F) Medium-sized paratype (from exuvia 18.IV.2013). (G-H) Small paratype (from exuvia 28.III.2012). Arrow indicating pronounced step between anterior lobes and lateral margin of poreplate. Scale lines 1.0 mm.

Description of female (allotype): *Colour in alcohol* (darker in life): Mostly dark brown. Eye mound and anterior margin of carapace black. Chelicerae dark brown distally, light brown proximally. Carapace with dark pattern including torch-shaped marking between eye mound and fovea. No dark annulations on legs and palps. Membranous cuticle of opisthosoma light greyish brown; tergites dark greyish brown. Ventral sclerites lighter than dorsal ones.

Setae on carapace: Several (more than in males) short, blunt setae on posterior and lateral margins and on coxal elevations of carapace; 10+14 setae in two parallel rows anterior to fovea.

Cheliceral teeth: 13 strong teeth on promargin of right cheliceral groove, 15 on left groove.

Claws: Palpal claws with 2 and 4 worn denticles. Paired tarsal claws of leg I with 3 teeth, of legs II-IV with 3-4 teeth; unpaired claws of legs I-II with 3 denticles, of leg III with 2-4 denticles, of leg IV with 1-2 denticles. All tarsi without scopula.

Vulva (Fig. 9A-B): Uterus externus with a distinct pair of lateral pockets on dorsal side (as illustrated for *L. ferox* sp. nov., Figs 11I-J, N, P, 12D, F). Vulval plate wider than long; its lateral folds well developed, carrying several hairs. Anterior margin of poreplate with a pair of strongly arched lobes, these close to each other and separated by a narrow and deep invagination; posterior margins of poreplate distinctly bulged; CDO slightly larger than in females of other species in same group, situated in centre of poreplate; receptacular cluster racemose, relatively small, slightly longer than wide, not reaching anterior margin of poreplate. Posterior stalk large, widely oval, narrower than poreplate.

Measurements: Total length 19.48; CL 7.85, CW 7.06; opisthosoma 8.65 long, 7.16 wide; eye mound 1.15 long, 1.31 wide; palpal coxa 2.73 long, 1.59 wide; labium 0.89 long, 1.99 wide; sternum 3.93 long, 2.04 wide (1.79 on ventral surface); palp 13.96 long (4.57 + 2.58 + 3.28 + 3.53); leg I 16.75 long (5.17 + 2.98 + 3.43 + 3.38 + 1.79); leg II 17.35 long (5.17 + 3.08 + 3.53 + 3.58 + 1.99); leg III 18.94 long (5.37 + 3.13 + 3.73 + 4.37 + 2.34); leg IV 26.05 long (7.06 + 3.38 + 5.22 + 7.06 + 3.33).

Variation: For carapace measurements and prefoveal setae counts see Table 1. In one female the left AME is missing, in another one it is indistinctly developed. In both males examined extent and density of the scopulae are the same. Variation in details of the male palp is illustrated in Fig. 8. The holotype has one of the proventral-distal bristles on the left palpal tarsus distinctly stronger than the other bristles (Fig. 8A). In contrast to the holotype, the male paratype has a smooth prodorsal margin of the para-embolic plate (Fig. 8H; dentate in the holotype, Fig. 8A, I). The number of longitudinal ribs reaching the apex of the sclerotised embolus part ranges from four to five. The pigmented area at the base of the membranous part of the embolus has a horizontal and fairly straight distal margin in the holotype, whereas in the male paratype it is widely and asymmetrically angular. Small females have distinctly annulated legs and palps, whereas in large females the annulations are indistinct to absent, obviously having faded as the spiders became older and larger. Variation in the shape of the vulval plates is shown in Fig. 9. The vulval plates of small (immature?) females have less pronounced anterior lobes, less bulging posterior poreplate margins, a relatively larger CDO, a relatively larger receptacular cluster with a partly unsclerotised base, and an anteriorly narrower posterior stalk than large females (Fig. 9E-H cf. Fig. 9A-D).

Relationships: Among males of the *birmanicus*-group a large para-embolic plate (common in species of the *trang*-group) is only found in *L. tung* sp. nov. and *L. ferox* sp. nov. (Fig. 8H-I and Fig. 10A-D). This appears to be a synapomorphy, but considering the wide geographical separation of both species (Fig. 1) it may actually be a homoplasy.

Distribution: The new species is only known from its type locality in the south-eastern part of the Shan State (Fig. 1).

Biology: The spiders examined were collected from the banks of a small stream running through fallow fields on a steep mountain side. All burrows were simple and unbranched, with a single trapdoor up to 2.0 cm long and 2.3 cm wide, and with up to eight signal lines, the longest measuring 8 cm. In captivity the two males became adult in burrows with 2.4-2.9 cm long and 1.8-2.0 wide trapdoors. Three egg cases, 2.2-3.0 cm long, 2.3-3.3 cm wide, 1.7-2.3 cm high, were found at the type locality in early January. They contained 56, 97 and 110 light yellow eggs suspended in a fine mesh of silken threads. The males matured in early January, after two and three years in captivity. Since at that period of the year egg cases were found in the wild, the mating dates of the males in captivity were obviously later than in nature.

Liphistius ferox Schwendinger & Huber, sp. nov.

Figs 1, 3A-B, 10-12

Holotype: MHNG-ARTO-0028317 (sample MT-14/10); male (matured 2.X.2014); Myanmar, Kayin State, Thandaung Lay (19°01'15"N, 96°35'00"E), 140 m; 16.VII.2014; leg. P.J. Schwendinger & S. Huber.

Paratypes: MHNG-ARTO-0028318 and MHNG-ARTO-0028319 (sample MT-14/10); 1 male (matured 1.IX.2014) and 1 female (allotype, MHNG-ARTO-0028319); collected together with the holotype. – BRCM, MHNG-ARTO-0028321 and MHNG-ARTO-0028322; 2 males (matured 7.X.2014, 18.IX.2016) and 1 female (sample MT-14/04);

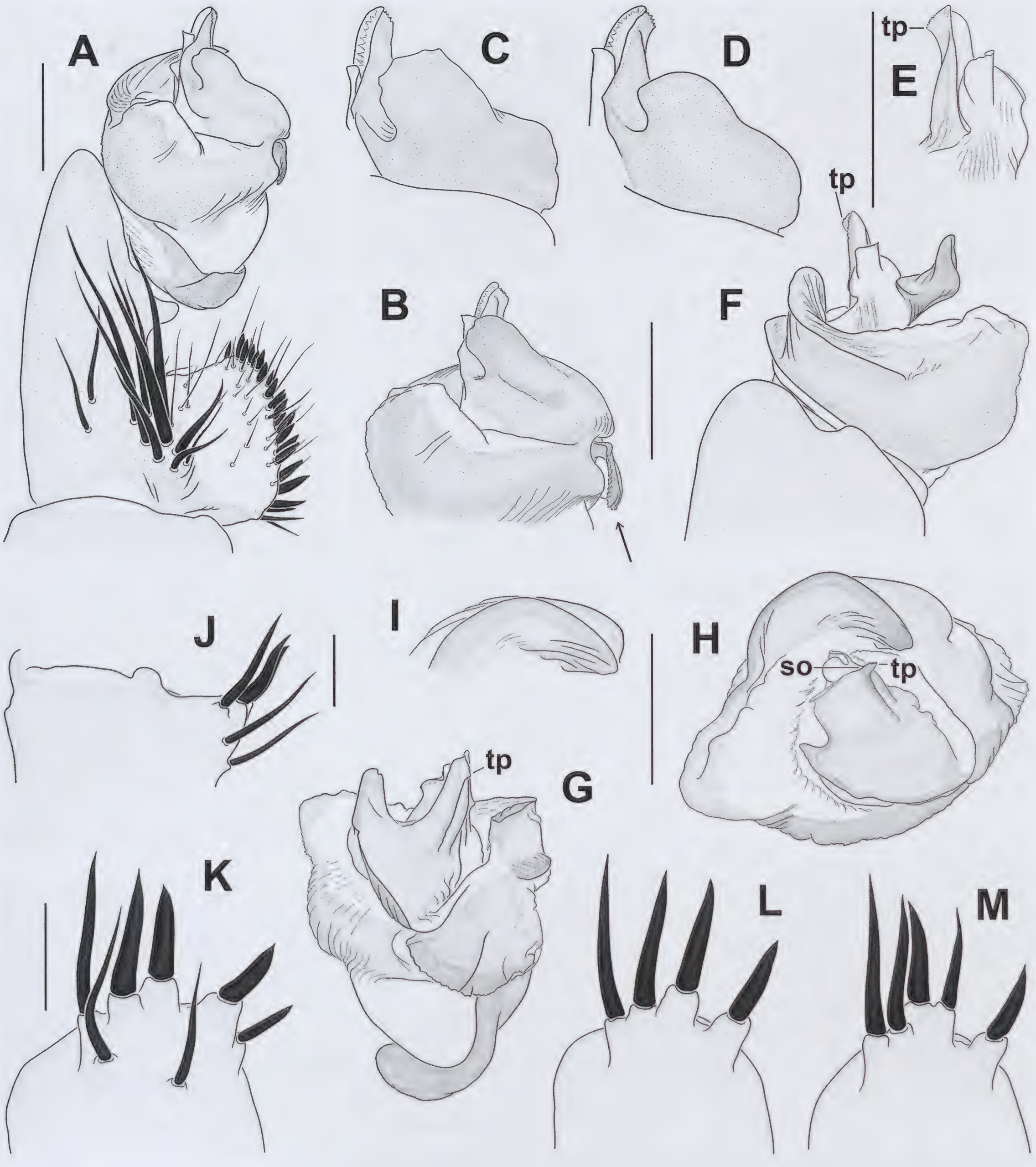
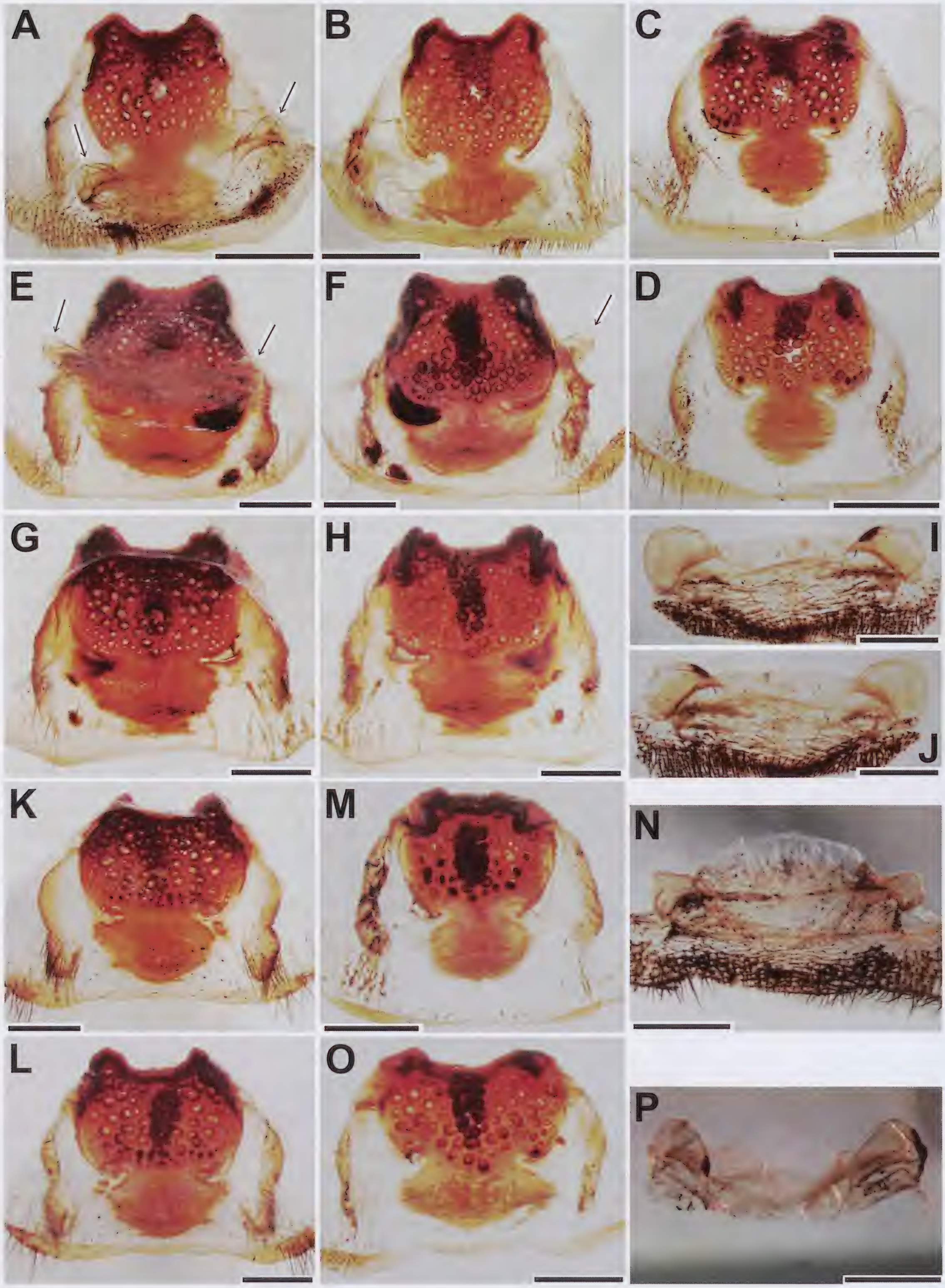


Fig. 10. *Liphistius ferox* sp. nov., left palps of four males; holotype (A-B, E-K), male from Naw Bubaw, matured IV.2019 (C, M), male from Thandaung Gyi, matured 7.X.2014 (D), male from Thandaung Gyi, matured 18.IX.2016 (L). (A) Tarsus and palpal organ, ventral view. (B) Distal part of palpal organ, ventral view; bent and adpressed proximal edge of tegulum indicated by arrow. (C-D) Embolus complex, ventral view. (F) Embolus proper, prodorsal view. (G) Palpal organ, retroventral view. (H) Palpal organ, distal view (dorsal side up). (I) Dorsal part of contrategulum, distal and slightly prolateral view. (J) Distal part of tarsus, ventral view. (K-M) Same, retrolateral and slightly proximal view. Scale lines 1.0 mm (A; B, F-G; C-E; H-I; J; K-M). Abbreviations: tp - triangular distal protrusion of longitudinal rib on sclerotised part of embolus proper; so - angular retrolateral side of sperm duct opening.


A
B
C
E
F
D
G
H
I
J
K
M
N
L
O
P

Myanmar, Kayin State, along road from Thandaung Lay to Thandaung Gyi, 850 m (19°01'54"N, 96°38'29"E); 12./14./16.VII.2014; leg. P.J. Schwendinger & S. Huber. – MHNG-ARTO-0028323 to MHNG-ARTO-0028333, BRCM (samples MT-14/07); 1 male (matured 10.IX.2014) and 11 females (samples MT-14/05 and MT-14/06); along same road, 1150 m (19°04'15"N, 96°40'37"E); 12./14./16.VII.2014; leg. P.J. Schwendinger & S. Huber. – MHNG-ARTO-0028335 to MHNG-ARTO-0028340 (samples O-234A and MT-14/07); 1 male (matured IV.2019) and 5 females; Myanmar, Kayin State, Mt Naw Bubaw (19°04'39"N, 96°41'12"E), 1350-1410 m; 12./14.VII.2014; leg. P.J. Schwendinger & S. Huber.

Other material: MHNG (sample MT-14/07); 3 juveniles; Myanmar, Kayin State, Mt Naw Bubaw (19°04'39"N, 96°41'12"E), 1350-1410 m; 12./14.VII.2014; leg. P.J. Schwendinger & S. Huber. – BRCM; 1 female; Myanmar, Kayin State, on roadside about 7 km E from border between Bago Region and Kayin State, Thaundaung Gyi Township (19°01'56.3"N, 96°38'39.2"E), 850 m; 6.VIII.2018; leg. H. Ono. – BRCM; 1 female; Myanmar, Kayin State, 21 miles E of Taungoo, Thaundaung Gyi Township, near Taw Pya Gyi Village (19°02'35.5"N, 96°39'38.1"E), 940 m; 6.VIII.2018; leg. H. Ono.

Etymology: The Latin adjective "ferox" (= wild, ferocious) refers to the exceptionally aggressive behaviour of these spiders.

Diagnosis: Distinguished from all other species of the *birmanicus*-group by the combination of very large size and uniformly dark body colouration in both sexes. Genital morphology similar to that of *L. tung*

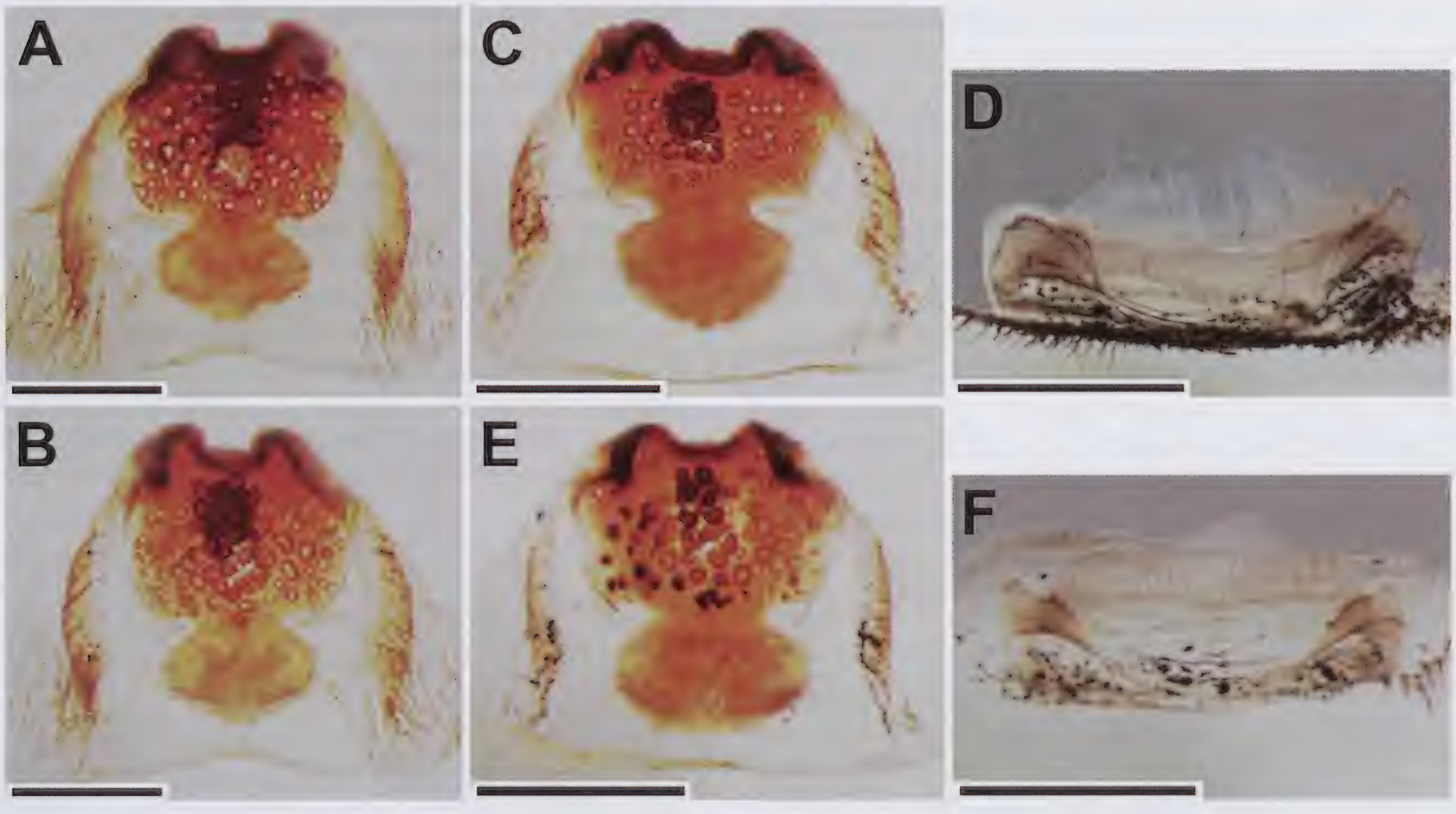


Fig. 12. *Liphistius ferox*, vulvae of three females; dorsal view (A, D, F), ventral view (B-C, E). (A-B) Thandaung Gyi, moulted 26.X.2014; vulval plate. (C) Thandaung Gyi, moulted 11.1.2015; vulval plate. (D) Same female; isolated uterus externus. (E) Thandaung Gyi, moulted 6.XII.2014; vulval plate. (F) Same female; isolated uterus externus. Scale lines 1.0 mm.

Fig. 11. *Liphistius ferox*, vulvae of seven females; dorsal view (A, C, E, G, I, K, N, P), ventral view (B, D, F, H, J, L-M, O). (A-B) Thandaung Gyi, moulted 21.VII.2015; with uterus externus attached (in B hidden on other side). (C-D) Thandaung Gyi, moulted 8.1.2015. (E-F) Thandaung Gyi, moulted 15.VII.2015; with uterus externus attached (in F only pocket of one side visible). (G-H) Thandaung Gyi, moulted 16.VII.2015; vulval plate. (I-J) Same female; isolated uterus externus. (K-L) Naw Bubaw, moulted 26.II.2015. (M) Allotype; Thandaung Lay, moulted 10.VII.2015, vulval plate. (N) Same female; isolated uterus externus. (O) Thandaung Gyi, moulted 20.IX.2014; vulval plate. (P) Same female; isolated uterus externus. Arrows indicating paired lateral pockets of still attached membranous uterus externus. Scale lines 1.0 mm.

◀

sp. nov., i.e. both species possessing a long para-embolic plate in males (Fig. 10A-D and Fig. 8A, H-I; short in other species of the *birmanicus*-group) and lacking anterolateral processes on the ventral side of the poreplate in females (Figs 11-12 and Fig. 9). Different from *L. tung* sp. nov. by much larger body size (CL in males 11.47-12.67, CW 10.45-11.47 versus 6.30-6.70 and 5.70-6.26 in *L. tung* sp. nov.); sclerotised embolus part with only 2 longitudinal ribs reaching apex, one of them with a triangular distal protrusion pointing retrodorsad (Fig. 10E-H); retrolateral side of sperm duct opening angular in distal view (Fig. 10H; in *L. tung* sp. nov. with 4-5 normal ribs and concave retrolateral side of sperm duct opening, Fig. 8C-D, F-I); proventral process of contrategulum relatively larger than in *L. tung* sp. nov. (Fig. 10H cf. Fig. 8C-D); tibial apophysis only slightly set back from distal margin of tibia (Fig. 10J; much further set back in *L. tung* sp. nov., Fig. 8B). Females different from those of *L. tung* sp. nov. by anterior lobes of poreplate folded ventrad and more widely separated from each other (Figs 11-12 cf. Fig. 9).

Description of male (holotype): *Colour in alcohol* (much darker in life, as in Fig. 3A): Mostly uniformly brown, ventral side of body slightly lighter than dorsal side; prolateral part of palpal coxae, proximal part of chelicerae and membranous cuticle of opisthosoma light brown; all opisthosomal tergites uniformly dark brown; legs and palps without annulations; palpal tarsus and sclerites of palpal organ dark brown; eye mound very dark.

Setae on carapace: Few short, blunt-tipped setae on coxal elevations and on lateral margin of carapace; strongest setae on posterior margin, longest setae on and behind eye mound; no setae anterior to fovea.

Cheliceral teeth: 12 small teeth of different sizes on promargin of each cheliceral groove.

Scopula: Distally divided by a short glabrous longitudinal stripe and proximally with a median row of stiff bristles on all tarsi; distinct but weak in distal 3/4 of ventral side of leg tarsus I; equally weak and covering distal 4/5 of tarsus II; slightly denser and more clearly outlined, covering 5/6 of tarsi III-IV.

Tarsal claws: Paired claws with 4-5 teeth on tarsi I-III, 3-5 teeth on tarsus IV; unpaired claw of tarsus I with 1 denticle, of tarsi II-III with 1-2 denticles, of tarsus IV bare.

Palp: Tibial apophysis of moderate size, widely triangular in ventral view, slightly set back from distal margin of tibia (Fig. 10J), carrying 5 apical megaspines: ventral one rather weak, longer than the others and ending in a filiform tip, following 3 megaspines shorter and stronger, dorsalmost megaspine shortest and weakest; 3 ventral megaspines situated on a common base, 2 dorsal ones each on a separate base (Fig. 10K; see also Variation). Distal margin of tarsus slightly invaginated (Fig. 10F). Paracymbium quite short, somewhat quadrangular, longer than wide in ventral view, moderately deep, its distal side only indistinctly conical, no retrolateral-proximal heel (Fig. 10A); cumulus developed as a slightly elevated and quite long, low mound carrying a densely packed group of 9 long strong bristles (Fig. 10A). Subtegulum with indistinct but recognizable apophysis (Fig. 10A, G). Tegulum wide, with slightly bent, adpressed, moderately serrate proximal edge (Fig. 10B, G); distal margin not elevated, overhung by unpigmented retroventral margin of embolus complex; with a short subdistal ridge (not to be misinterpreted as an elevated distal tegular edge) and two longer more proximal ridges (Fig. 10G). Pigmented bridge between tegulum and contrategulum on retrodorsal side of palpal organ well developed (Fig. 10G-H). Contrategulum with quite large (in comparison with other species of the same group), conical proventral process ending in a rounded apex in distal view (Fig. 10H); a few wrinkles on dorsal surface and a well-developed proximal ledge on retrodorsal side (Fig. 10F, H-I); distal edge of contrategulum widely arched and carrying pronounced ridges below narrowly rounded dorsal apex (Fig. 10H-I). Para-embolic plate large, toungue-shaped, inclinded prodorsad, its widely rounded apex with a small indentation (Fig. 10A-B; see also Variation). Retroventral edge of embolus complex elevated into a short, widely arched keel (Fig. 10A-B). Embolus proper with sclerotised part strengthened by only 2 longitudinal ribs reaching apex and carrying tiny denticles distally, ventral rib with a triangular distal protrusion pointing prodorsad (Fig. 10E-H); retrolateral side of sperm duct opening (i.e. inner side of sclerotised embolus part) angular in distal view (Fig. 10H; concave in other congeners, e.g. Fig. 15A); membranous part of embolus proper distinctly shorter than sclerotised part, both narrowly divided; at base of membranous embolus part a fairly long and strongly pigmented area with numerous longitudinal wrinkles, its distal margin strongly oblique; embolic folds short and indistinct (Fig. 10E-F).

Measurements: Total length 28.97; CL 12.59, CW 11.81; opisthosoma 13.28 long, 8.97 wide; eye mound 1.37 long, 1.80 wide; palpal coxa 3.62 long, 2.50 wide; labium 1.12 long, 2.24 wide; sternum 6.03 long, 3.45 wide (1.72 on ventral surface); palp 21.90 long (6.21 + 4.05 + 7.76 + 3.88); leg I 35.09 long (9.66 + 5.17 + 7.41 + 8.88 + 3.97); leg II 36.72 long (9.83 + 5.34 + 7.67 + 9.74 + 4.14); leg III 39.57 long (9.83 + 5.43 +7.93 + 11.55 + 4.83); leg IV 48.45 long (12.07 + 5.69 + 9.57 + 15.09 + 6.03).

Description of female (allotype): *Colour in alcohol* (distinctly darker in life, as in Fig. 3B): Mostly dark brown. Eye mound and anterior margin of carapace very dark. Chelicerae dark brown distally, orange-coloured proximally. Carapace without pattern; legs and palps without annulation. Tergites and membranous cuticle of opisthosoma almost equally dark greyish brown. Ventral side of palpal coxae, distal part of labium, ventral plates

of opisthosomal segments II-III, and spinnerets orange-coloured. Sternum greyish orange-coloured.
Setae on carapace: Mostly as in male, but setae on posterior margin longer and thinner; 3+4 setae (some very small) in two parallel rows anterior to fovea.
Cheliceral teeth: 14 strong teeth on promargin of right cheliceral groove, 15 on left groove.
Claws: Palpal claws with 2 and 3 worn denticles. Paired tarsal claws of legs I-II with 3 teeth, of leg II with 4 teeth, of legs III-IV with 3-4 teeth; unpaired claw of leg I with 1 denticle, of leg II with 2, of leg III with 1-2 denticles, of leg IV with 0-1 denticle. All tarsi without scopula.
Vulva (Fig. 11M-N): Uterus externus with a pair of quite large lateral pockets on dorsal side (see Fig. 11N; see also Figs 11I-J, P, 12D, F for other females). Vulval plate slightly wider than long; its lateral folds well-developed and carrying several hairs. Anterior margin of poreplate thick, with a pair of narrow anterior lobes bent ventrad and separated by a shallow, mostly horizontal invagination (but see Variation); no anterolateral processes; posterior margins of poreplate not bulged; CDO small, situated in centre of poreplate; receptacular cluster racemose, distinctly longer than wide, not reaching anterior margin of poreplate. Posterior stalk large and widely oval, narrower than poreplate.
Measurements: Total length 35.34; CL 15.26, CW 13.97; opisthosoma 15.34 long, 13.28 wide; eye mound 1.75 long, 2.13 wide; palpal coxa 5.34 long, 3.79 wide; labium 1.81 long, 3.45 wide; sternum 7.93 long, 4.31 wide (2.59 on ventral surface); palp 25.95 long (8.19 + 5.00 + 6.55 + 6.21); leg I 31.46 long (9.83 + 6.03 + 6.38 + 6.81 + 2.41); leg II 32.93 long (10.17 + 6.21 + 6.38 + 7.41 + 2.76); leg III 35.94 long (10.34 + 6.55 + 6.72 + 8.97 + 3.36); leg IV 47.94 long (13.10 + 6.90 + 9.31 + 13.97 + 4.66).

Variation: For carapace measurements and prefoveal setae counts see Table 1. All spiders examined have well-developed AME. Large and small specimens of both sexes lack annulations on legs and palps. In all males examined the extent and density of the scopulae are the same; all have a very similar shape of their proventral contrategular process, all have only two longitudinal ribs reaching the apex of the sclerotised embolus part (one of the ribs with a triangular distal protrusion), and all have an angular inner side of the sclerotised embolus part. The ventral part of the tibial apophysis carries a group of 3-4 rather long apical megaspines on a common base, the dorsal part a group of 1-2 rather short megaspines on a separate base; both bases are separated by a distinct invagination (Fig. 10K-M). The indistinctly elevated cumulus carries 6-9 long and very strong bristles (some of them almost as thick as the megaspines on the tibial apophysis). All but one male (matured 1.IX.2014) have a more or less distinctly developed, short subdistal ridge on the tegulum that can be misinterpreted as an elevated distal margin (Fig. 10G). There is some variation in the number of ridges on the surface of the tegulum and in their lengths. The distal margin of the large para-embolic plate is widely rounded or has one or more angles in most specimens (Fig. 10C-D); it is slightly invaginated on the left palp of the holotype (Fig. 10A-B). The pigmented area at the base of the membranous embolus part has a distal margin that varies between straight, slightly invaginated, slightly inclined and asymmetrically angular. Variation in details of the male palp is illustrated in Fig. 10. Variation in the shape of the vulval plate is considerable and shown in Figs 11-12. The anterior lobes of the poreplate (which are mostly quite small) are completely bent ventrad, towards the receptular cluster, in the allotype (Fig. 11M), less distinctly so in other females examined (Figs 11B, D, F, H, L, O, 12B-C, E), and the invagination between these lobes is more or less straight and horizontal, but always wide and shallow; all females lack anterolateral processes on the poreplate; the posterior margins of the poreplate are mostly indistinct, bulging only in one female and there probably deformed on one side (Fig. 11F), therefore not typical for the species. The receptacular cluster is much longer than wide in most females, in one specimen even reaching the anterior margin of poreplate (Fig. 11H); only in one of the females examined is the receptacular cluster only slightly longer than wide (Fig. 12C). The posterior stalk usually has a short anterior constriction, except for one female which obviously has deformed posterior poreplate margins (Fig. 11E-F; the same appears to be the case, but only on one side and therefore probably also representing a deformation or an excessive sclerotisation, in a second female, Fig. 11G-H). The shape of the posterior stalk varies from widely oval (e.g. Fig. 11M) to narrowly (e.g. Fig. 12C) or widely axe-blade-shaped (e.g. Fig. 11O). The lateral folds of the vulval plate carry few to many hairs.

Relationships: The new species possesses unique and autapomorphic characters on the sclerotised part of its embolus proper, i.e. only two longitudinal ribs, one of them with a triangular distal protrusion (Fig. 10E-H); the retrolateral surface of sperm duct opening compressed and angular in distal view (Fig. 10H). It clearly is not very closely related to *L. birmanicus*, despite close geographical proximity and similar body size. Similarities in the morphology of male and female copulatory organs (especially the presence of a large para-embolic plate and the absence of anterolateral processes on the poreplate) indicate a much closer relationship between *L. ferox* sp. nov. and *L. tung* sp. nov. than between *L. ferox* sp. nov. and *L. birmanicus*. However, the geographical separation of *L. ferox* sp. nov. and *L. tung* sp. nov. by about 400 km severely challenges a possible sister relationship between these two species.

Distribution: The type specimens were collected along the road from Thandaung Lay (also called Pathi

Village) in the lowlands at 140 m altitude, past a station at 850 m, to Thandaung Gyi Village at about 1150 m, and further up to below the summit of Mount Naw Bubaw at 1350-1410 m (Fig. 1). This is the largest known altitudinal range for any *Liphistius* species. The paralectotypes of *L. birmanicus* from the Biapo Mountains near Leiktho (spelled "Leito" in Fea, 1896), about 15 km north of Thandaung Gyi and Naw Bubaw, presumably also belong to *L. ferox* sp. nov. (see Remarks under *L. birmanicus*).

Biology: The specimens examined were collected from earth banks on both sides of a road running through secondary forest and evergreen hill forest. All burrows were simple and unbranched, closed by a single trapdoor. The largest trapdoor in females was 4.3 cm long and 6.5 cm wide, those of penultimate males 2.8-3.5 cm long and 3.9-5.0 cm wide. Most burrow entrances had 6-8 signal lines attached, the longest measuring 8 cm, a single burrow was equipped with nine signal lines.

Males matured in captivity between early September and early October, only a few months after being captured. The maturation date in June 2019, after almost five years of captive rearing, is not likely to correspond to conditions in nature. No egg cases were found in mid-July; they are presumably constructed in December (as in conspecific species in northern Thailand). Large females usually moulted once per year, between July and February; smaller females moulted for a second time between March and May. Two spiders, a female from Thandaung Gyi at 1150 m and a juvenile male from Naw Bubaw at 1400 m, carried ectoparasitic mites of the genus *Ljunghia* (see Halliday & Juvara-Bals, 2016) on them. The mites left bite marks on the carapace and chelicerae (in the proximal and distal portions) as observed in other *Liphistius* spp., and additionally also on the soft and flexible membranes between coxae, trochanters and femora of the palps and of the first pair of legs. The latter has not been observed in other such cases. Previously there was only evidence that these mites pierce strongly sclerotised parts of the spider exoskeleton to feed, an unusual behaviour so far unexplained.

Liphistius birmanicus Thorell, 1897

Figs 1, 3D-I, 13-14

Liphistius birmanicus Thorell, 1897: 162-169 (description of females). – Pocock, 1900: 156 (English summary of Thorell's lengthy original description in Latin). – Bristowe, 1933: 1025, figs 6, 7b, 8d, 9a (comparison and illustration of characters of female). – Bristowe, 1938: 661 (misidentification; description of immature male of an unnamed *Liphistius* species from Moulmein). – Bristowe, 1975: 166-167 (new report based on misidentied specimen belonging to *L. bristowei* Platnick & Sedgwick, 1984). – Haupt, 1983: 280, figs 5c, 6c (illustration of vulval plate of female erroneously referred to as the holotype and later selected as the lectotype by Platnick & Sedgwich, 1984). – Platnick & Sedgwick, 1984: 8-10, figs 7-13 (designation of lectotype; description of incorrectly identified males and females belonging to *L. pyinoolwin*). – Schwendinger, 1990: 331-332, figs 1-4 (illustration of copulatory organs of incorrectly identified male and female *L. pyinoolwin* specimens in AMNH).

Types: MCSNG; female lectotype of *L. birmanicus*; Myanmar, Kayin State, Yadò (spelled Ja-dò in Fea, 1896: 457-458, fig. 149), in montibus Carin Asciuii Chebà, 1200-1300 m; 1885-1888; leg L. Fea. – MCSNG; 2 immature paralectotypes of *L. birmanicus*; Myanmar, Kayin State, in montibus Carin Chebà sive Biapò, 1000-1200 m; 1885-1888; leg. L. Fea. Not examined.

Remarks: Leonardo Fea (1852-1903) collected the types of *L. birmanicus* between December 1887 and January 1889 (Fea, 1897: 391). The original description states that the two juvenile specimens (the paralectotypes from Biapò, given as situated at 900 m altitude in Fea, 1896: 391) have entirely dark legs and palps ("toti nigricantes vel sordide fusci"), whereas the adult female (the lectotype from Yadò) has a carapace that is partly brick-red and partly dark ("cephalothorax praesertim in parte thoracica paullo testaceo-fusco-variatus") as well as bicoloured legs and palps: mostly dark ("ad maximam partem… nigricantes vel sordide fusci"), with dark brick-red femora and dark brick-red annulations on patellae, tibiae and metatarsi ("patellae, tibiae et metatarsi, et etiam femora supra, vestigiis annuli vel annulorum binorum testaceo-fuscorum praedita"; Thorell, 1897: 166). This indicates that the paralectotypes from Biapò are not conspecific with the lectotype from Yadò, because small females from Yadò have bicoloured legs and palps as do the corresponding large females (Fig. 3G cf. Fig. 3E-F, H-I). It is quite likely that the paralectotypes belong to *L. ferox* sp. nov., because Biapò is much closer to Thandaung Gyi than to Yadò (Fea, 1896: pl. 3), and because *L. ferox* sp. nov. has an exceptionally large vertical distribution (from 140 m to 1400 m). It presumably also has a correspondingly large geographical range.

New material: MHNG, BRCM (sample MT-14/33); 6 males (matured 24.IX.2014, 30.X.2014, 15.XI.2014, 27.I.2016, 28.II.2016, 9.XI.2017) and 10 females; Myanmar, Kayin State, farmland and rice fields in the southern part of the Yado (= Yadò) Valley, near the southernmost village called "Preisciò" in Fea (1896: 458, pl. 3), 19°19'50"N, 96°48'29"E, 1100 m; 18.-19.VI.2014; leg. P. Schwendinger & S. Huber. – MHNG (sample MT-14/35); 1 female; Myanmar, Shan State, roadside about 3 km NE of the northern end of the Yado Valley, 19°23'20"N, 96°49'29"E, 1130 m; 19.VI.2014; leg. P. Schwendinger.

Diagnosis: Quite large spiders (CL in males 7.79-9.50, in the largest female 14.73, CW in males 7.29-9.45, in the largest female 13.27) with parts of legs, palps and carapace (especially pars cephalica) of females and late instar juvenile males yellow or orange-coloured (Fig. 3E-I; Xu *et al*., 2021: fig. 2I). Palp of male similar to that of much smaller *L. pinlaung* male, both possessing a distad-directed proventral contrategular process (Fig. 13D, F and Fig. 15C). Different from *L. pinlaung* by a more oval palpal organ in distal view (Fig. 13A cf. Fig. 15A), a wider and shorter pigmented area at base of membranous embolus part (Fig. 13D cf. Fig. 15C) and a widely arched retrolateral paracymbium side lacking a proximal heel (Fig. 13H cf. Fig. 15G). Vulval plate distinguished from that of uniformly dark brown *L. pinlaung* female by anterior lobes of poreplate closer to each other and posterior stalk more angular in shape (Fig. 14 cf. Fig. 16).

Additions to description: Males mostly with uniformly dark brown sclerites (Fig. 3D; Xu *et al*., 2021: fig. 2J), apart from an orange-coloured area in posterior portion of cephalic carapace part in some males (see Variation), and with weak scopulae on tarsi I-II, slightly denser ones on tarsi III-IV, covering only distal 1/2 of tarsus I, distal 2/3 of tarsus II, distal 3/4 of tarsus III and distal 4/5 of tarsus IV in most males (see also Variation). Male palp with moderately deep tibial apophysis (depth/length ratio ~ 1.8), relatively small and triangular in ventral view, only slightly set back from distal margin of tibia (illustrated as distinctly set back in Xu *et al*., 2021: fig. 8A), carrying four long pointed apical megaspines; distal margin of palpal tarsus widely but shallowly invaginated, with a small knob-shaped process on distodorsal corner (Fig. 13C); paracymbium short, somewhat globular in ventral view, its retrolateral surface widely and evenly arched, without a proximal heel (Fig. 13H); cumulus slightly elevated, carrying a dense group of several long strong bristles close to each other and arranged in two rows (Fig. 13H); subtegulum without apophysis (Fig. 13E); tegulum large, its distal margin not elevated, its proximal edge widely arched, finely dentate, bent and overhanging membranous area below it (Fig. 13E-G); contrategulum with proventral process conical and inclined distad (almost parallel to axis of embolus proper), its apex narrowly rounded (Fig. 13A, D-F; Xu *et al*., 2021: fig. 8D-F); a few oblique wrinkles on dorsal surface (Fig. 13D) and a pronounced proximal ledge on retrodorsal side (Fig. 13A, D, G); distal edge of contrategulum moderately wide, with a few ridges and a narrowly rounded dorsal apex (Fig. 13A-B), prolateral part of edge elevated and developed as a distinct keel (Fig. 13D); para-embolic plate short, about as long as retroventral edge of embolus complex and separated from it by a shallow invagination (Fig. 13E-F); embolus proper with sclerotised part strengthened by 5-6 longitudinal ribs reaching apex and carrying denticles distally, narrowly divided from distinctly shorter membranous embolus part; short area at base of membranous part strongly pigmented, with numerous longitudinal wrinkles, its distal margin wide and slightly oblique (Fig. 13D). Females with few to several hairs on lateral folds of vulval plate; poreplate as long as wide (Fig. 14N-O), or wider than long (Fig. 14A-M), posteriorly wider than anteriorly, with a pair of rather indistinct (Fig. 14L) to very wide, rounded lobes (Fig. 14N-O) on anterior margin, and with a small pair of anterolateral processes; CDO fairly small, round, quadrangular or triangular (Fig. 14A, D, G, J, N); receptacular cluster racemose, slightly to distinctly longer than wide, not reaching anterior margin of poreplate (Fig. 14B-C, E-F, H-I, K-M, O; Xu *et al*., 2021: figs 9-10); posterior stalk narrower than poreplate, axe-blade-shaped, with posterior margin widely arched (Fig. 14G-I, L) or trapezoidal, in the latter case posterior margin straight and narrower than median part of posterior stalk (Fig. 14A-F, J-K, M-O); transition from poreplate to posterior stalk usually distinctly constricted (see also Variation).

Variation: For carapace measurements and prefoveal setae counts see Table 1. In all specimens the AME are distinctly developed. The number of setae anterior to the fovea ranges 11-25 in males and it is over 40 (continuous with other setae on pars cephalica of carapace) in all females. Three males have a distinct orange-coloured area in the posterior portion of the pars cephalica; in one male this area is only indistinct; in the remaining two males it is not visible. In the female from the Shan State the carapace has a larger orange-coloured area than in females from Yado, with the W-shaped dark marking behind its eye mound only continuous in the middle, the lateral parts developed as series of dark spots. In males the extent of the tarsal scopulae is slightly variable: I - 1/2-2/3, II - 2/3-3/4, III - 3/4-4/5, IV - 4/5. Variation in details of the male palp is given in Fig. 13. In one of the males examined the tibial apophysis is slightly further set back from the distal margin of the palpal tibia than in other males, but not as far as illustrated in Xu *et al.,* 2021: fig. 8A. Variation in the shape of the vulval plate is considerable (see Fig. 14; Xu *et al*., 2021: figs 9-10). The anterior margin of the poreplate is indistinctly (Fig. 14J-K) to deeply invaginated (Fig. 14N-O); the poreplate is usually clearly wider than long (Fig. 14A-M), in one female as long as wide (Fig. 14N-O); the anterior lobes of the poreplate are indistinct (Fig. 14J-K) to very distinct (Fig. 14N-O); the CDO is small (Fig. 14A) to very small (Fig. 14N), round in most females, developed as a longitudinal slit or triangle in two specimens (Fig. 14D, G); the pores on the dorsal side of the poreplate are quite large (Fig. 14A, J) to small (Fig. 14N); the lateral margins of the poreplate vary from widely arched (Fig. 14J-K) to almost straight

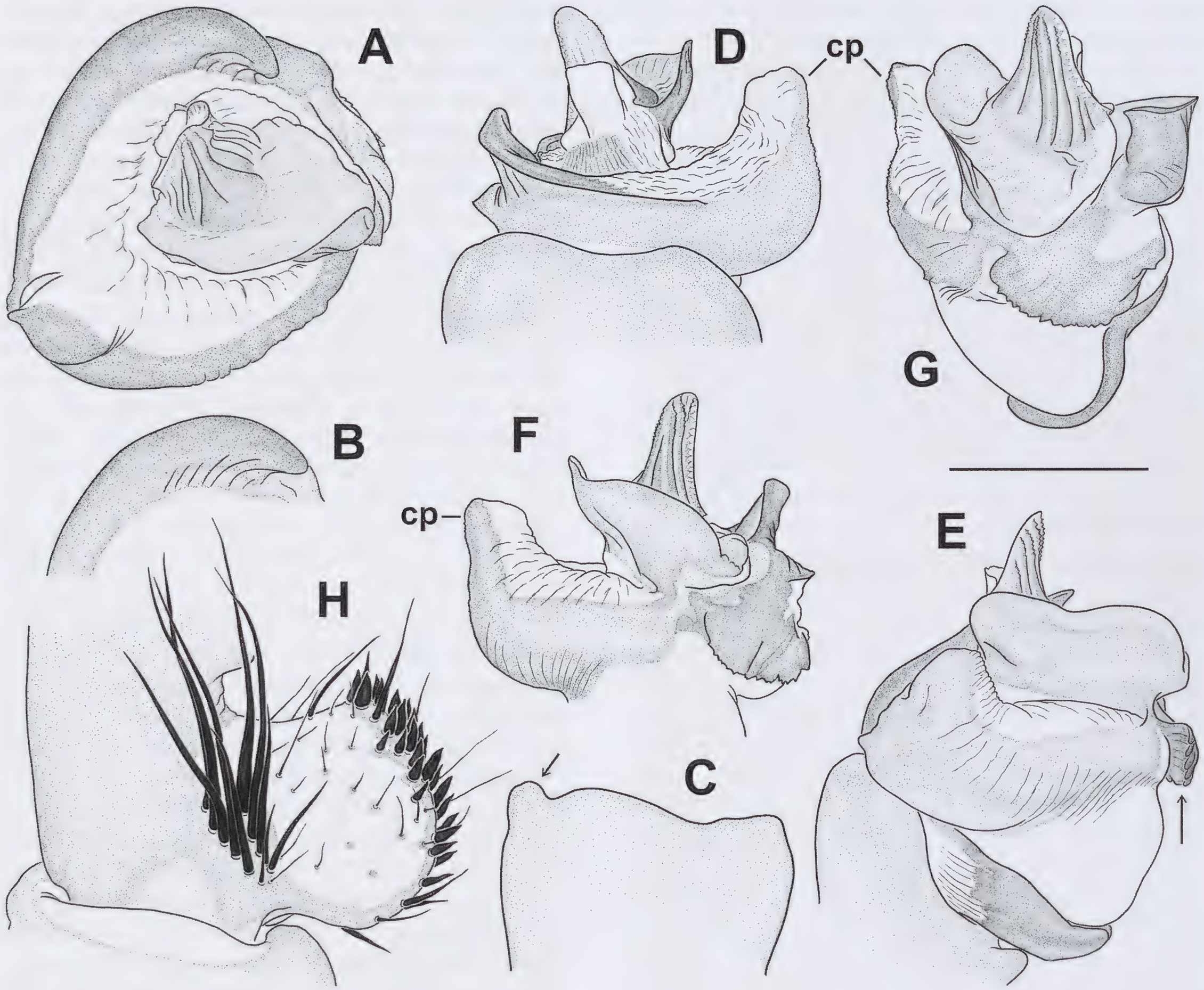
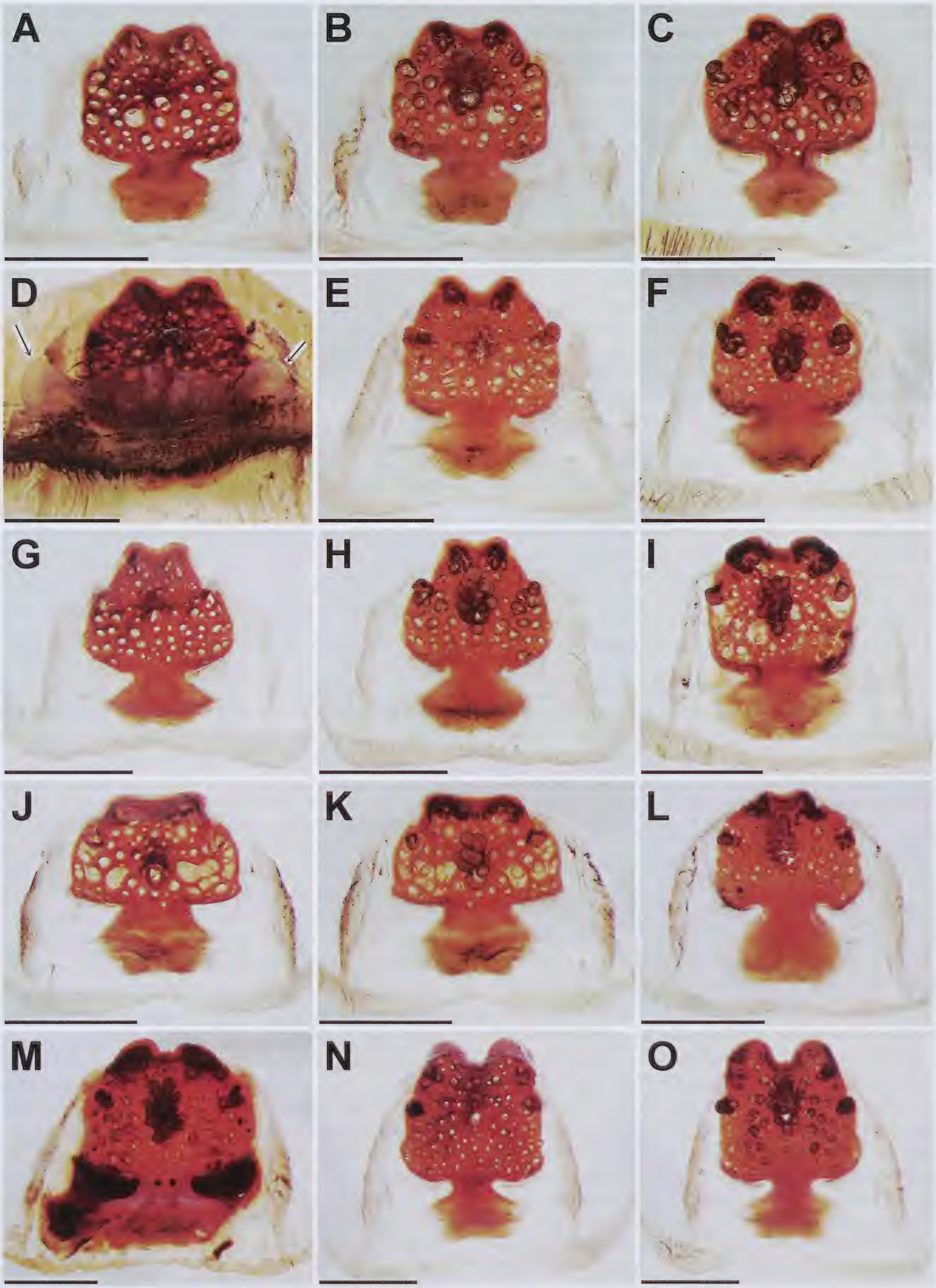


Fig. 13. *Liphistius birmanicus*, left palps of two males from the type locality; male matured 27.I.2016 (A-B), male matured 15.XI.2014 (C-H). (A) Palpal organ, distal view (dorsal side up). (B) Dorsal part of contrategulum, distal and slightly prolateral view. (C) Distal part of tarsus, prodorsal view; knob-shaped process on distodorsal corner indicated by short arrow. (D) Palpal organ and distal margin of tarsus, prolateral view. (E) Same, ventral view; bent proximal edge of tegulum indicated by long arrow. (F) Distal part of palpal organ, retroventral and slightly proximal view. (G) Palpal organ, retrolateral view. (H) Proximal part of tarsus, ventral view. Scale line 1.0 mm. Abbreviation: cp - proventral contrategular process.

Fig. 14. *Liphistius birmanicus*, vulval plates (all taken from exuviae) of ten females from the type locality (A-M) and of one female from the Shan State (N-O); dorsal view [A, D (with uterus externus attached), G, J, N], ventral view (B-C, E-F, H-I, K-M, O). (A-B) Moult of 6.II.2021. (C) Moult of 27.XII.2020. (D) Moult of 20.XI.2021. (E) Moult of 19.II.2021 (same specimen as D). (F) Moult of 21.II.2021. (G-H) Moult of 25.XII.2020. (I) Moult of 14.V.2021. (J-K) Moult of 20.III.2021. (L) Moult of 26.X.2017. (M) Moult of 24.VIII.2017. (N-O) Moult of 2.IV.2018. Arrows indicating paired lateral pockets of membranous uterus externus. Scale lines 1.0 mm.


A
B
C
D
E
F
G
H
I
J
K
L
M
N
O

(Fig. 14N-O); the posterior stalk is constricted at the base, trapezoidal, posteriorly narrower than medially in most females, axe-blade-shaped in two specimens (Fig. 14G, L), or widely connected to the poreplate without a constriction in another specimen (Fig. 14M, presumably deformed). It should be noted that almost all vulval plates had more or less distinct dark soiling, especially along the posterior margins of the poreplate (removed by forceps in the illustrated vulvae). These are remnants of old cuticle, and the older the spider, the denser and thicker these remaining fragments of old cuticle are. In one of the large females this presumably caused deformation at the posterior poreplate margin and at the base of the posterior stalk (Fig. 14M; see also Xu *et al*., 2021: fig. 9F, I). Tiny fragments of old cuticle are also visible inside the lateral folds of the vulval plate in some specimens (e.g. Fig. 14B, I-M). The anterolateral processes on the ventral side of the poreplate are always present, but not always very pronounced (Fig. 14B).

Relationships: Males of *L. birmanicus* and *L. pinlaung* share a strongly distad-directed proventral process of the contrategulum, which is unique within the genus and indicates a close phylogenetic relationship (in addition to geographical proximity) between these two species despite pronounced differences in body size and colouration. Judging from the body colouration of females and juveniles and from vulval plate morphology it is quite likely that *L. birmanicus* is even more closely related to *L. hpruso* than to *L. pinlaung*. However, as long as the male of *L. hpruso* remains unknown or until molecular data of these three species are available for comparison, the relationship between these species cannot be confirmed. For a morphological distinction between *L. birmanicus* and *L. hpruso* see Taxonomic remarks under the latter species.

Distribution: *Liphistius birmanicus* is known from the mountainous area where the Kayin State, the Kayah State and the Shan State meet (Fig. 1). The report of a damaged immature *L. birmanicus* male from Moulmein (= Mawlawmyine) by Gravely (1915: 260; see also Bristowe, 1938: 661) is most likely incorrect. *Liphistius* males and females collected at two localities near Mawlawmyine belong to the *bristowei*-group.

Biology: The specimens examined were collected from earth banks on the sides of rice fields, vegetable fields and ditches. Most burrows were simple and unbranched, closed by a single trapdoor; one penultimate male had two doors. The largest trapdoor in females was 3.5 cm long and 5.1 cm wide, those of penultimate males 2.0-2.4 cm long and 3.2-3.6 cm wide. Burrow entrances had 6-8 relatively thick and short signal lines attached, the longest measuring 6 cm.

The first three males matured in captivity between early September and mid-November, only a few months after being captured. Two maturations of males, in January and February, occurred about 1.5 years after capture and presumably do not correspond with such events in nature. No egg cases were found in the field in late June; they are presumably constructed in December (as in conspecific species in northern Thailand). Most large females moulted twice per year.

One of the males examined (matured 30.X.2014) had parasitic mites (*Ljunghia* sp.) sitting on its carapace (especially in the fovea), on the membranous cuticle behind the carapace, on opisthosomal tergites I-II (where mite exuviae were attached) and on the labium and sternum. As usual, the mites left numerous bite marks on the carapace, but not on the chelicerae (or on any other body parts).

Liphistius hpruso Aung, Xu, Lwin, Sang, Yu, Liu, Liu & Li, 2019

Fig. 1

Liphistius hpruso Aung *et al*., 2019: 32-34, fig. 3A-E (description of females).

Types: CBEE; female holotype (XUX-2018-151) and 1 female paratype (XUX-2018-152); Myanmar, Kayah State, Loikaw District, Hpruso, Dokhule, 19.41°N, 97.10°E, 1157 m; 17.VII.2018; D. Li, F.X. Liu, X. Xu & L. Yu. Types not examined; no new material available.

Taxonomic remarks: Judging from illustrations in the original description, this species appears to be closely related to *L. birmanicus* and *L. pinlaung* from which it can be distinguished by a distinctly longer and narrower posterior stalk of the vulval plate (Aung *et al*., 2019: fig. 3B-E cf. Figs 14, 16). The body colouration of the female holotype (Aung *et al*., 2019: fig. 3A; however, carapace colouration given as "light brown" and leg colouration as "brown", see p. 33 in same paper) is similar to that of young (not fully grown) females of *L. birmanicus* (Fig. 3G). In addition to close geographical proximity, this indicates a very close phylogenetic relationship between *L. hpruso* and *L. birmanicus*. We thus assume that the not yet known male of *L. hpruso* also possesses a distad-directed proventral contrategular process.

Distribution: This species is only known from its type locality (Fig. 1), about 30 km to the east of the known localities of *L. birmanicus* and roughly at the same altitude.

Liphistius pinlaung Aung, Xu, Lwin, Sang, Yu, Liu, Liu & Li, 2019

Figs 1, 3C, 15, 16A-J

Liphistius pinlaung Aung, Xu, Lwin, Sang, Yu, Liu, Liu & Li, 2019: 34-37, figs 4-5 (description of males and females).

Types: CBEE; male holotype (XUX-2018-164), 1 male and 5 female paratypes (XUX-2018-162, 167, 169,

169A, 169B, 169J); Myanmar, Shan State, Pinlaung Township, about 14 km to Pinlaung from Pekon, 20.02°N, 96.79°E, 1410 m; 19.VII. 2018; leg. D. Li, F.X. Liu, X. Xu and L. Yu.

New material: MHNG, BRCM (sample MT-14/31); 10 males (matured 20.VI., 21.VI., 28.VI., 20.VIII., 17.IX., 23.IX.2014, 23.XI., 2x end of XII.2014, 4.VII.2015) and 10 females; Myanmar, Shan State, 1.5 km W of Pinlaung, near Wingabar Taung and Tong Htiwaw (= Taung Hti Bwar) Temple, 20°04'29"N, 96°46'13"E, 1470 m; 16.VI.2014; leg. P. Schwendinger & S. Huber.

Diagnosis: Medium-sized species with uniformly dark body in both sexes. Copulatory organs quite similar to those of *L. birmanicus*. Palpal organ distinguished by having a fairly circular outline in distal view (Fig. 15A; in *L. birmanicus* oval and relatively wider, Fig. 13A) and a relatively longer and narrower pigmented area with a more steeply inclined distal margin at base of membranous embolus part (Fig. 15C; in *L. birmanicus* much wider, its distal margin horizontal or only slightly inclined, Fig. 13D). Vulval plates usually, but not in all cases, with a relatively wider poreplate than in *L. birmanicus* and with an axe-blade-shaped or widely elliptical posterior stalk with a widely arched posterior margin (Fig. 16; posterior stalk angular, mostly with a straight posterior margin in *L. birmanicus*, Fig. 14).

Additions to description of male: Tarsal scopulae: I - thin, covering 3/4 of ventral side, distinct in distal half, more or less distinct in proximal half; II - thin but slightly denser than on tarsus I, covering distal 5/6 of ventral side; III-IV - denser than on tarsi I-II, covering 5/6 of ventral side. Male palps with tibial apophysis quite distinctly set back from distal margin of tibia (more so than in the *L. birmanicus* males examined; but see Xu *et al.*, 2021: fig. 8A-B), triangular in ventral view, depth/length ratio ~ 1.9 (see Aung *et al.*, 2019: fig. 4D-E); paracymbium quite short, its distal surface indistinctly conical, its retrolateral surface flat, with a moderately developed, widely rounded retrolateral-proximal heel (Fig. 15G); very strong bristles on low cumulus overlapping strong bristles on ventral side of palpal tarsus (Fig. 15G); contrategulum with quite large, distad-directed proventral process (Fig. 15A, C-E; very similar to that of *L. birmanicus*, Fig. 13A, D-F), with a pronounced proximal ledge on retrodorsal side (Fig. 15A), and with a moderately wide distal edge with a few weak ridges and a narrowly rounded dorsal apex (Fig. 15A-B); tegulum large, with finely dentate and bent proximal edge (Fig. 15D, F), distal margin not elevated [in some specimens a fairly long ridge is present just below the distal margin (in addition to a long median ridge) which can be misinterpreted as an elevated edge, Fig. 15F]; para-embolic plate short, about as long as retroventral edge of embolus complex and separated from it by a shallow invagination (Fig. 15D); embolus proper narrowly divided, its sclerotised part strengthened by 4-5 longitudinal ribs reaching apex and carrying denticles distally; area at base of membranous embolus part quite long and narrow, distinctly pigmented, with numerous longitudinal wrinkles, its distal margin widely truncate and steeply inclined (this area is much wider in *L. birmanicus*, its distal margin is not or only slightly inclined, Fig. 13D).

Taxonomic remarks: As can be seen from the relatively light body colouration and from the partly collapsed paracymbium, the male holotype was obviously killed and preserved very soon after its final moult. Metatarsus and tarsus of both its legs IV were very pale when still alive, and additionally deformed (due to a weak sclerotisation of the new cuticle) in the preserved specimen (Aung *et al.*, 2019: figs 2D, 4B). These leg articles obviously got stuck in the exuvia during the final moult, and were not able to become fully pigmented and sclerotised before the spider was killed. Therefore the light-coloured left metatarsus and tarsus IV of the holotype are an artefact caused by a moulting accident, and they are not a diagnostic character of the species as incorrectly stated by Yu *et al.* (2021: 37, incorrectly spelled "*L. pinglaung*"). The fact that the proventral process of the contrategulum is distad-directed, which is characteristic for *L. pinlaung* as well as *L. birmanicus*, is not mentioned in the original description or visible in the corresponding illustrations (Aung *et al.*, 2019: 36, fig. 4).

Variation: For carapace measurements and prefoveal setae counts see Table 1. In all specimens the AME are distinctly developed. In all males examined the extent of the tarsal scopulae is essentially the same, but in some specimens the proximal borders of the scopulae are less distinctly outlined than in others. Variation in details of the male palp is given in Fig. 15. The number of very strong bristles on the cumulus ranges 4-7: in most males examined (apart from one) they overlap strong bristles on the ventral side of the palpal tarsus (Fig. 15G). In five males examined there is a more or less distinct ridge below the distal margin of the tegulum of both palps (and in one male on only one palp; Fig. 15F), which can be misinterpreted as an elevated distal edge. A real elevated distal tegular edge is present in *L. platnicki* sp. nov. (Fig. 23I-M), in *L. nabang* (Yu *et al.*, 2021: fig. 3A-B, D-E) and in males of other species groups. Small females have distinctly annulated legs, in large females the annulations have become indistinct. Variation in the shape of the vulval plate is considerable, especially in shape and size of the anterior lobes and the distance between them, and in the shape of the posterior stalk (Fig. 16A-J; Aung *et al.*, 2019: fig. 5). The posterior margin of the posterior stalk is mostly straight in all three female paratypes illustrated in Aung *et al.* (2019: fig. 5), much like in females of *L. birmanicus* (Fig. 14), whereas in the females examined by us it ranges from straight (Fig. 16D-E), to widely rounded

(Fig. 16I-J) and very widely V-shaped (Fig. 16C). The poreplate of the smallest female examined has an exceptionally small receptacular cluster and relatively large pores (some much larger than the CDO; Fig. 16I-J). This appears to be a general feature of young (immature?) females rather than a case of individual variation in this species. The same female also has a single hair between the poreplate and the posterior stalk, which is unusual for species of the *birmanicus*-group (but see vulval plates of some species in Peninsular Malaysia, Schwendinger, 2017: figs 7, 9, 13, 14I-J).

Relationships: Despite pronounced differences in body colouration of females and juveniles, similarities in male (especially in the distad-directed proventral contrategular process) and female copulatory organs indicate a close relationship between *L. pinlaung* and *L. birmanicus*. *Liphistius hpruso* may also be very closely related, but that needs to be confirmed by the discovery of its male or by genetic analysis.

Distribution: *Liphistius pinlaung* is known from two localities near Pinlaung Village in the western part of the Shan State (Fig. 1).

Biology: The specimens examined were collected from earth banks on the sides of a road and of rice fields. All burrows were simple and unbranched, closed by a single trapdoor. The largest trapdoor in females was 2.0 cm long and 2.5 cm wide, those of penultimate males 1.2-1.7 cm long and 1.7-2.4 cm wide. Burrow entrances had 6-8 signal lines attached, the longest measuring 5 cm. The first three males matured within two weeks after being captured, a fourth one over three months later; maturation in November of the following year and of July of the year after that are presumably due to conditions in captivity. Most females moulted twice per year, in June to July and again in October to December; old females moulted only once per year.

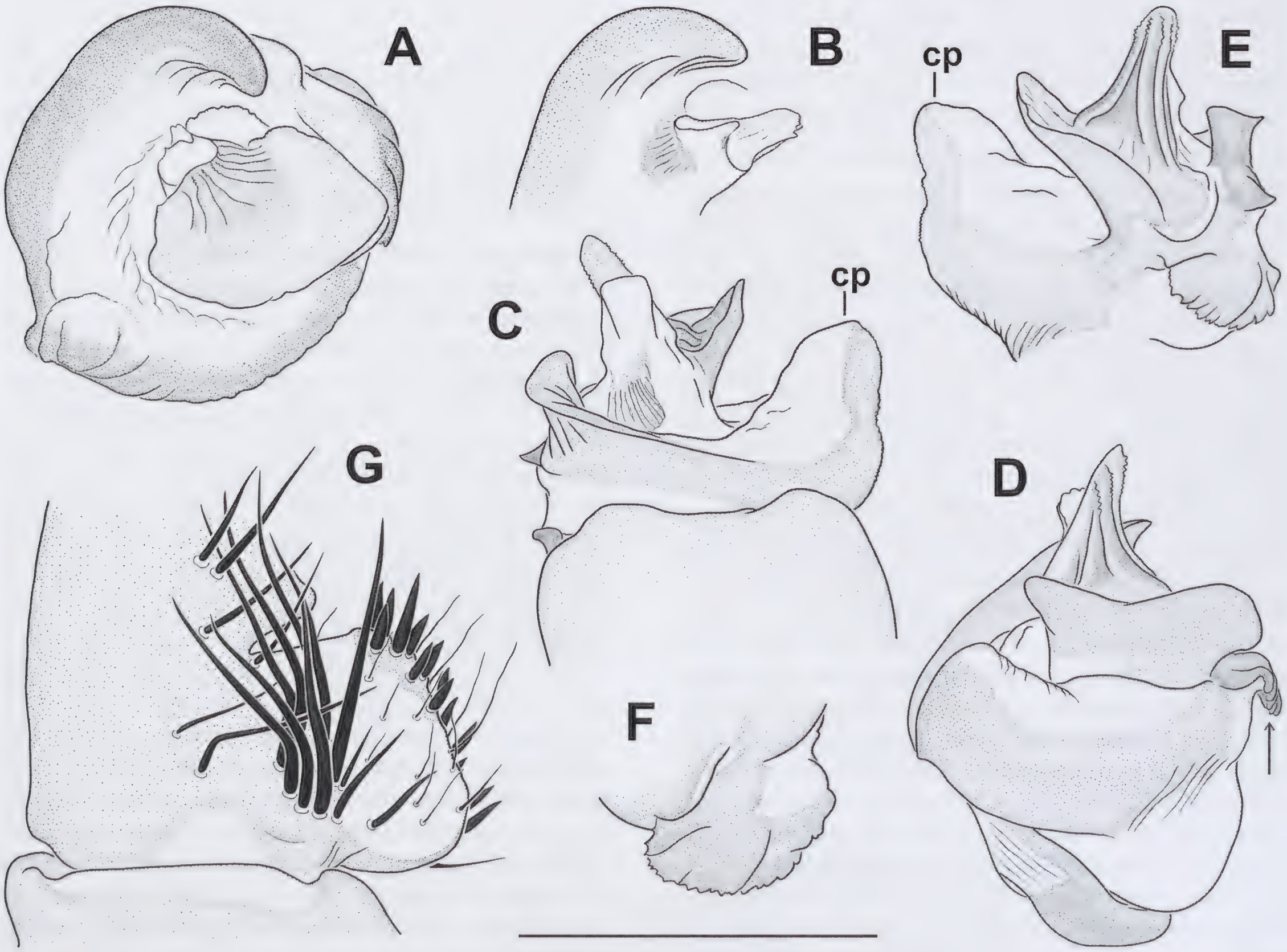


Fig. 15. *Liphistius pinlaung*, left palps of two males: matured 23.XI.2014 (A-B), matured 4.VII.2015 (C-G). (A) Palpal organ, distal view (dorsal side up). (B) Dorsal part of contrategulum and embolus proper, distal and slightly prolateral view. (C) Palpal organ and distal margin of tarsus, prolateral view. (D) Palpal organ, ventral view; bent proximal edge of tegulum indicated by arrow. (E) Distal part of palpal organ, retroventral view. (F) Tegulum, retrolateral view. (G) Proximal part of tarsus, ventral view. All to same scale; scale line 1.0 mm. Abbreviation: cp - proventral process of contrategulum.

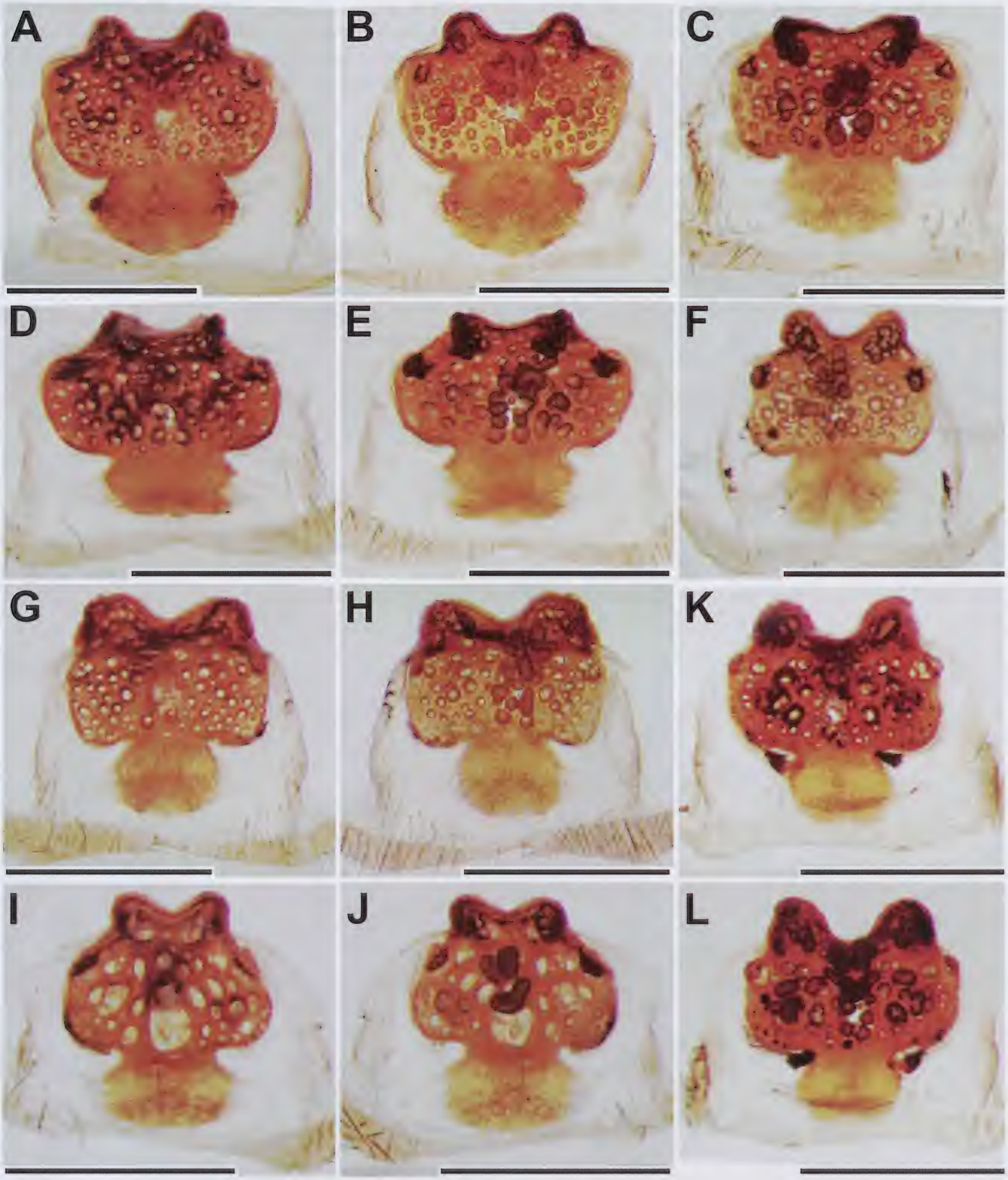


Fig. 16. *Liphistius pinlaung* (A-J) and *Liphistius* sp. (specimen from Kalaw; K-L), vulval plates of seven females (all taken from exuviae), dorsal view (A, D, G, I, K) and ventral view (B-C, E-F, H, J, L). (A-B) Moult of 10.II.2019. (C) Moult of 7.XII.2018. (D-E) Moult of 10.IV.2021. (F) Moult of 21.X.2018. (G-H) Moult of 16.V.2020. (I-J) Moult of 8.III.2020. (K-L) Moult of 15.VIII.2017. Scale lines 1.0 mm.

Liphistius sp.

Figs 1, 16K-L

Material: MHNG (sample MT-14/29); 1 female; Myanmar, Shan State, 3 km SW of Kalaw, along road to water reservoir, 20°36'16"N, 96°32'06"E, 1400 m; 14.VI.2014; leg. P. Schwendinger & S. Huber.

Taxonomic remarks: Body size and colouration and the shape of the vulval plate of this female is quite similar to that of *L. pinlaung* females (Fig. 16K-L cf. Fig. 16A-J). The vulval plate differs by larger and more deeply separated anterior lobes, by a longer receptacular cluster (reaching anterior margin of poreplate), and by a relatively shorter posterior stalk. This female (CL 7.34, CW 6.15 and thus within the size range of *L. pinlaung* females) either belongs to a different species, or it is a specimen at the far end of intraspecific variability in females of *L. pinlaung*.

Distribution and biology: The locality of this female lies about 50 km north of the known localities of *L. pinlaung* (Fig. 1), at roughly the same altitude. This form or species appears to be locally rare. Despite intensive search in the area around Kalaw for two full days, only a single spider was found. It was extracted from a simple burrow, closed by a 2.8 cm wide and 2.12 cm long trapdoor, with an old (filled with mould), 2.2 cm wide, 2.1 cm long and 1.3 cm high egg case at its end. In captivity the spider moulted two months after capture.

Liphistius lordae Platnick & Sedgwick, 1984

Figs 1, 17-18

Liphistius lordae Platnick & Sedgwick, 1984: 10-11, figs 18-19 (description of female). – Schwendinger, 1990: 332-334, figs 5-10 (description of males and females). – Schwendinger, 1998: fig. 1I (illustration of palpal organ). – Schwendinger, 1999: fig. 1I (reprint of illustration in Schwendinger, 1998).

Type: AMNH; female holotype (not examined); Myanmar, Shan State, west of Taunggyi Mountain, 5000 feet; 15.VII.1982; leg. W.C. Sedgwick.

Other material: MHNG; 2 males (one collected adult, the other matured 26.IX.1987) and 4 females; outskirts of Taunggyi City, 20°45'17"N, 97°02'27"E, 1560 m; 22.IX.1987; leg P. Schwendinger. No new material available.

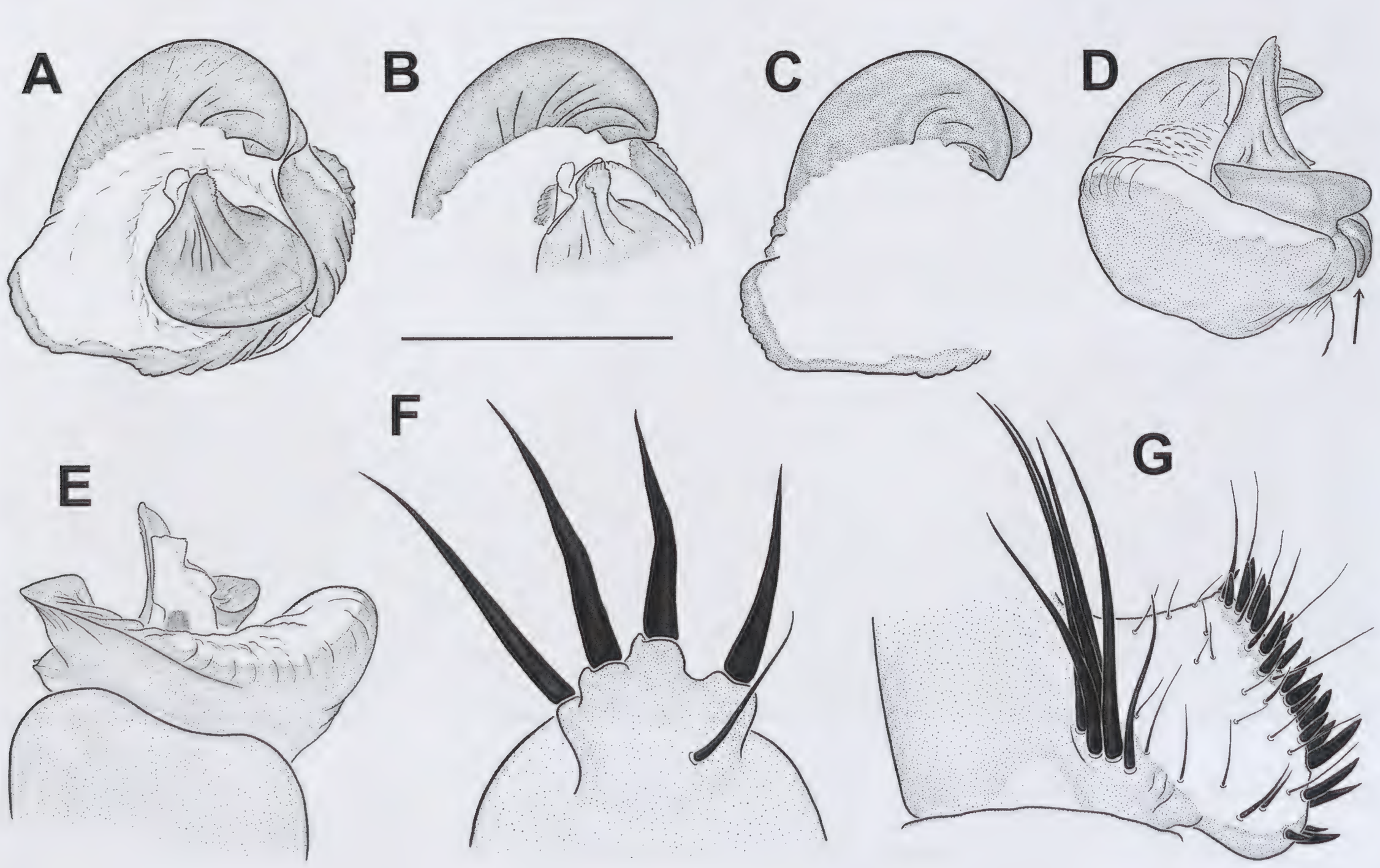


Fig. 17. *Liphistius lordae*, left palps of two males: male n°1 (A-B, D-G), male n°2 (C). (A) Palpal organ, distal view (dorsal side up). (B) Dorsal part of contrategulum and embolus proper, distal and slightly prolateral view. (C) Contrategulum, distal view. (D) Distal part of palpal organ, ventral view; bent and adpressed proximal edge of tegulum indicated by arrow. (E) Palpal organ and distal margin of tarsus, prolateral view. (F) Tibial apophysis, retrolateral and slightly proximal view. (G) Proximal part of tarsus, ventral view. Scale line 1.0 mm.

Diagnosis: Medium-sized spiders with uniformly dark brown body colouration in both sexes, without recognizable annulations on legs and palps. Males distinguished from those of other species in the *birmanicus*-group by short paracymbium with a proximally protruding, rounded proximal-retrolateral heel (Fig. 17G) and by proventral contrategular process exceptionally wide, with a widely truncate apex in distal view (Fig. 17A, C). Females different from those of the same group by having exceptionally wide anterior lobes, no anterolateral processes on poreplate, posterior stalk with a medium-long constriction in its anterior part (Fig. 18).

Additions to description: Males with scopulae weak on tarsi I-II, slightly denser on tarsi III-IV, covering distal 2/3 of tarsus I, distal 3/4 of tarsi II-III and distal 4/5 of tarsus IV. Male palps with moderately deep tibial apophysis (depth/length ratio ~ 1.5), only slightly set back from distal margin of tibia, carrying four long, pointed apical megaspines (Fig. 17F; Schwendinger, 1990: figs 5-7); paracymbium short, carrying fairly long retrodorsal spicules (distinctly longer than in *L. lahu*, *L. metopiae* sp. nov. and *L. tung* sp. nov.) and a large, arched retrolateral-proximal heel distinctly inclined proximad instead of pointing retrolaterad (Fig. 17G); cumulus indistinct, carrying a group of about 6 long

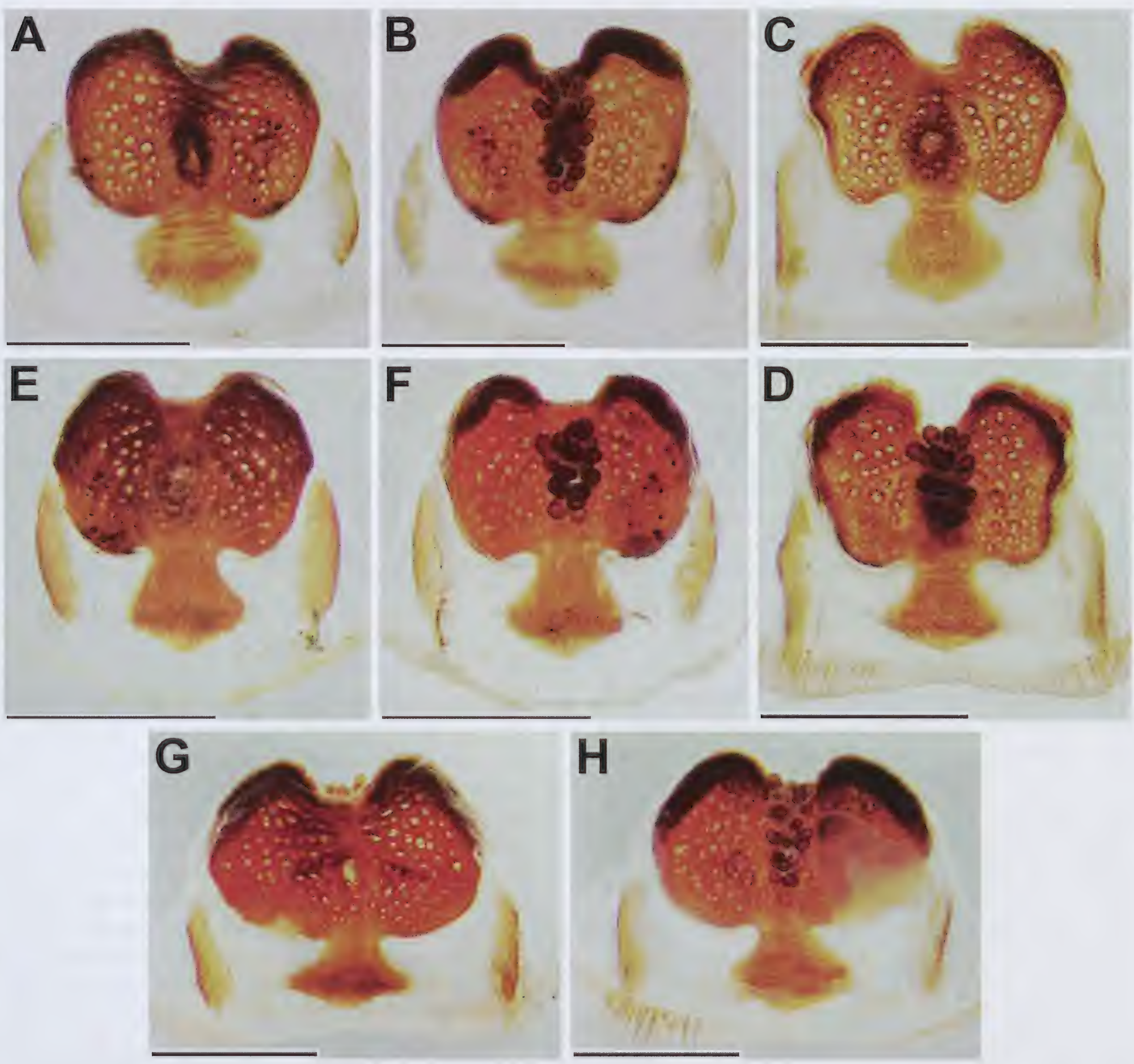


Fig. 18. *Liphistius lordae*, vulval plates of four females; dorsal view (A, C, E, G) and ventral view (B, D, F, H); all taken from exuviae. (A-B) Female n°1. (C-D) Female n°2. (E-F) Female n°3. (G-H) Female n°4; note pathologically enlarged vesicle on left side of poreplate. Scale lines 1.0 mm.

strong bristles (Fig. 17G; Schwendinger, 1990: figs 6-7); subtegulum with indistinct apophysis; tegulum large, its distal margin not elevated, its proximal edge widely arched, finely serrate, distinctly bent and adpressed to membranous area below it (Fig. 17D; Schwendinger, 1990: figs 5-6); contrategulum with very wide proventral process ending in a widely truncate apex (Fig. 17A, C; Schwendinger, 1990: fig. 7); prolateral part of distal contrategular edge sharp but not elevated into a pronounced keel (Fig. 17E); proximal ledge on retrodorsal side of contrategulum pronounced (Fig. 17A, C, E); distal edge of contrategulum very wide and carrying ridges, its dorsal apex very narrowly rounded, almost pointed in distal view (Fig. 17A-C); para-embolic plate short, about as long as retroventral edge of embolus complex and not separated from it by an invagination (Fig. 17A, D); embolus proper narrowly divided, its sclerotised part strengthened by 3 longitudinal ribs reaching apex and carrying denticles distally; membranous embolus part distinctly shorter than sclerotised part, short area at its base strongly pigmented, with numerous longitudinal wrinkles and with fairly straight or widely and strongly asymmetrically angular distal margin (Fig. 17E). Females with uniformly dark legs and palps without annulations; vulval plates (Fig. 18; Schwendinger, 1990: figs 8-10) with several hairs on lateral folds, one female even with a single hair on posterior stalk (Fig. 18E); poreplate wider than long, anteriorly wider than posteriorly, with a pair of very wide lobes on anterior margin, without anterolateral processes, posterior margins not bulged; CDO fairly small, quite variable in shape; receptacular cluster racemose, much longer than wide, reaching or almost reaching anterior margin of poreplate; posterior stalk clearly narrower than poreplate, axe-blade-shaped, with distinct anterior constriction, posterior margin wide and more or less strongly arched.

Variation: For carapace measurements and prefoveal setae counts see Table 1. All specimens examined have well-developed AME. Variation in the shape of the proventral contrategular process is shown in Fig. 17, variation in the shape of the vulval plates in Fig. 18.

Relationships: *Liphistius lordae* possesses some quite unusual characters in the male and female copulatory organs that make it difficult to establish its relationships on a morphological basis. It clearly belongs to the *birmanicus*-group and it is apparently not very closely related to the geographically close *Liphistius* sp. that occurs near Kalaw or to *L. pinlaung*. Within the *birmanicus*-group a very wide distal contrategular margin is otherwise only found in *L. pyinoolwin* (Fig. 17A-C cf. Fig. 19A-B), and both also share an adpressed posterior tegular edge, which are not very strong indications that both are more closely related to each other than each of them with any other known species. However, we believe that unknown species exist that are more closely related to either of these two species.

Distribution: *Liphistius lordae* is known only from the type locality in the mountains of the Shan State (Fig. 1).

Liphistius pyinoolwin Xu, Yu, Aung, Yu, Liu, Lwin, Sang & Li, 2021

Figs 1, 2B, 19-20

Liphistius birmanicus Thorell, 1897 (misidentification): Platnick & Sedgwick, 1984: 8-10, figs 7-15 (description of males and females in AMNH under *L. birmanicus*). – Schwendinger, 1990: 331-332, figs 1-4 (illustration of copulatory organs of 1 male and 3 females in AMNH misidentified as *L. birmanicus*).

Liphistius pyinoolwin Xu, Yu, Aung, Yu, Liu, Lwin, Sang & Li, 2021: 45-50, figs 2D-E, 3-7 (description of males and females).

Type material: CBEE (XUX-2018-089 to XUX-2018-111A); male holotype, 7 male paratypes and 15 female paratypes (not examined); Myanmar, Mandalay Region, Pyin Oo Lwin District, Dat Taw Gyaint Waterfall (= Anisakan Falls), 908 m, 21.98°N, 96.38°E; 13.VII.2018; leg. Li, Liu, Xu and Yu.

Material examined: MHNG, BRCM (sample MT-14/31); 12 males (matured 4.IX., 11.IX., 24.IX., 25.IX., 1.X., 4X., 5.X., 16.X.2014, 19.X., 20.X.2014, 3.IX., 5.X.2015) and 3 females; Myanmar, Mandalay Division, Pyin U Lwin (= Pyin Oo Lwin) District, Anisakan Waterfalls (21°58'50"N, 96°23'11"E), 600 m; 8.VII.2014; leg. P.J. Schwendinger & S. Huber. – AMNH; 2 males (matured 14.X.1982 and 23.X.1982; one of them illustrated in Platnick & Sedgwick, 1984: figs 7-11, 14 and in Schwendinger, 1990: fig. 1) and 5 females (one of them illustrated in Platnick & Sedgwick, 1984: figs 12-13, 15, three of them in Schwendinger, 1990: figs 2-4); gorge near Maymyo (= Pyin U Lwin = Pyin Oo Lwin), 3500 feet; 13.VII.1982; leg. W.C. Sedgwick.

Diagnosis: Medium-sized, dark spiders with annulated legs and palps (on posterior legs more distinctly so than on anteriors) in females and juvenile males. Males distinguished from those of other species in the *birmanicus*-group by paracymbium carrying 2-3 enlarged spicules (longer than the ones distal to them) on a narrowly rounded retrolateral-proximal heel (Fig. 19E-F); base of embolus complex prolaterally with a lobate protrusion (Fig. 19A-B). Females similar to those of *L. lordae*, distinguished by having annulated legs and palps; poreplate with a pair of anterolateral processes (absent in *L. lordae*); anterior lobes of poreplate quite narrow (very wide in *L. lordae*); posterior stalk posteriorly narrower than in *L. lordae* (Fig. 20 cf. Fig. 18).

Additions to description: Males with scopulae very weak on tarsus I (especially in proximal half),

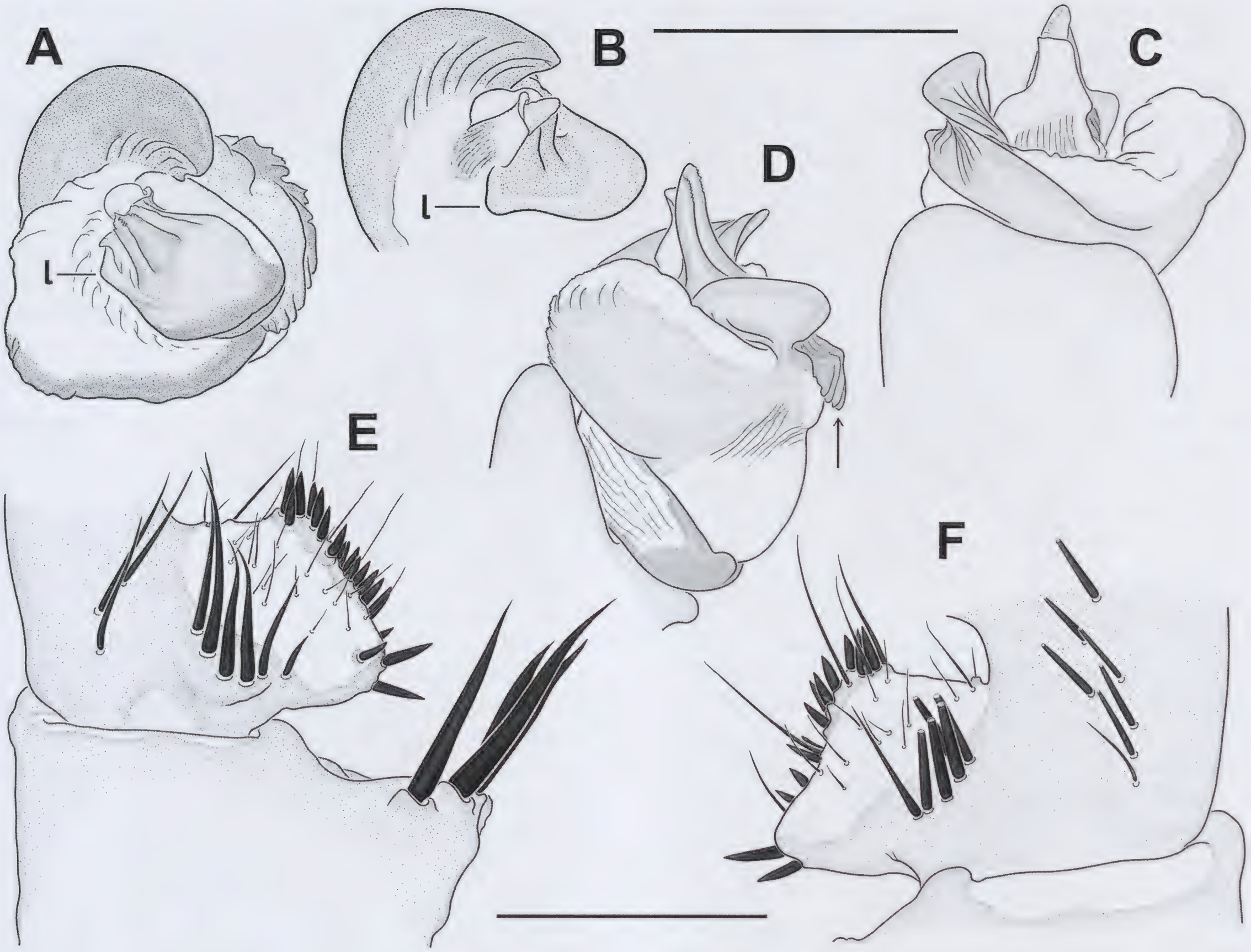


Fig. 19. *Liphistius pyinoolwin*, palps of two males: matured 16.X.2014 (A-E), matured 24.IX.2014 (F). (A) Left palpal organ, distal view (dorsal side up). (B) Left embolus complex and dorsal part of contrategulum, distal and slightly proventral view. (C) Left palpal organ and distal margin of tarsus, prolateral view. (D) Left palpal organ, ventral and slightly proximal view; bent and adpressed proximal edge of tegulum indicated by arrow. (E) Distal part of left tibia and proximal part of tarsus, ventral view. (F) Distal margin of right tibia and proximal part of tarsus, ventral view. Scale lines 1.0 mm (A-D; E-F). Abbreviation: l - lobate prolateral protrusion on base of embolus complex.

increasingly denser on tarsi III-IV, covering distal 3/4 of tarsus I, distal 4/5 of tarsus II and distal 5/6 of tarsi III-IV. Male palp with tibial apophysis slightly set back from anterior margin of tibia (Fig. 19E); paracymbium with a moderately to narrowly rounded retrolateral-proximal heel, always carrying 2-3 elongate spinules (longer than those situated more distally; Fig. 19E-F); distal margin of tegulum not elevated, proximal edge coarsely dentate, bent and adpressed to contrategular surface below it (Fig. 19D); contrategulum with short, widely conical proventral process with a rounded apex (Fig. 19A); distal edge of contrategulum very wide (Fig. 19A), its prolateral part long, slightly elevated to a keel (Fig. 19C), its dorsal apex narrowly rounded (Fig. 19A-B); base of embolus complex with a lobate prolateral protrusion (Fig. 19A-B); para-embolic plate short and indistinct, not separated by an invagination from retroventral edge of embolus complex (Fig. 19D); embolus proper narrowly divided, its sclerotised part strengthened by 3 longitudinal ribs reaching apex and carrying denticles distally (Fig. 19A-B, D); area at base of membranous embolus part wide, distinctly sclerotised and furnished with numerous quite long and deep wrinkles, its distal margin oblique (Fig. 19B-C). Females with a pair of light marks half way between ocular mound and fovea; poreplates wider than long, with distinct, quite narrow (distinctly narrower than in *L. lordae*) anterior lobes and with anterolateral processes; posterior stalk mostly axe-blade-shaped, with an exceptionally long and narrow constriction in its anterior part (Fig. 20, Xu *et al.*, 2021: figs 5-7, see also Variation).

Variation: For carapace measurements and prefoveal setae counts see Table 1. All specimens examined

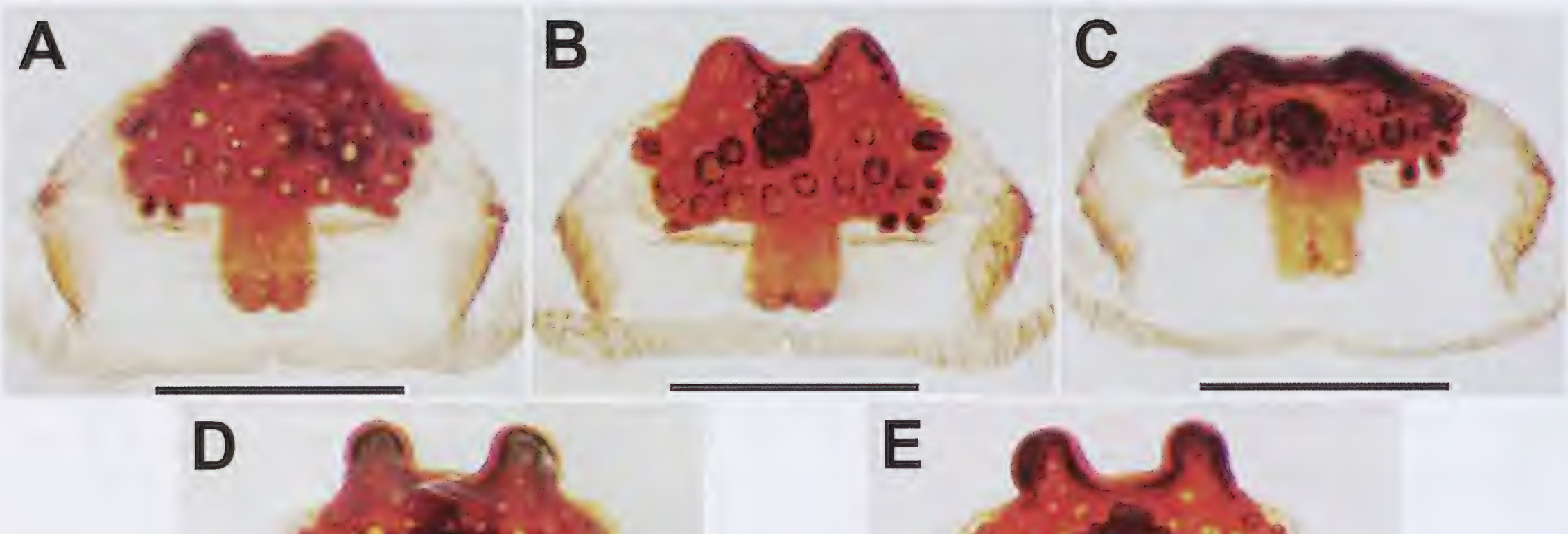


Fig. 20. *Liphistius pyinoolwin*, vulval plates of three females (all taken from exuviae), dorsal view (A, D, F), ventral view (B, E, G) and ventral and slightly anterior view (C). (A-C) Moult of 1.IX.2017. (D-E) Moult of 15.X.2017. (F-G) Moult of 22.I.2016. Scale lines 1.0 mm.

have well-developed AME. Variation in the shape of the male palp is shown in Fig. 19. In distal view the apex of the proventral contrategular process is widely rounded in most specimens (Fig. 19A), in one it is very widely triangular. The unusually deep apex of this process shown in prolateral view (Fig. 19C) is due to an artificial swelling (caused by alcohol preservation?) of the membrane on its distal side. This is not so in illustrations by Xu *et al*. (2021: figs 3-4). The distinctly pigmented area at the base of the membranous embolus part has an oblique distal margin (Fig. 19C), in some specimens with a small median spike or a longer spike at the higher end. In illustrations of male palps by Xu *et al*. (2021: figs 3-4) two characteristic features (elongate spicules on lower retrolateral corner of paracymbium; bent and adpressed proximal edge of tegulum) are not clearly visible or not visible at all; a third characteristic feature (lobate prolateral protrusion of embolus complex) is recognizable (Xu *et al*., 2021: fig. 3B, I). Variation in the shape of the vulval plates of three females examined is shown in Fig. 20. One of these specimens has wart-like ventral vesicles on the posterior margin of the poreplate and a very narrow posterior stalk (with roughly parallel lateral margins; Fig. 20A-C). This is presumably abnormal, as is the vulval plate illustrated by Xu *et al*. (2021: fig. 6F, I) which completely lacks a posterior stalk. The posterior margin of the posterior stalk is straight (Xu *et al*., 2021: fig. 5E, H) or more or less widely arched, with a small median invagination (Fig. 20), with a very small median lobe (Xu *et al*., 2021: figs 6E, 7D-E, G-H) or with neither (Xu *et al*., 2021: figs 5D, G, 6D, G, 7B-C, F, I). The receptacular cluster of this species is also quite variable, not or only barely reaching the anterior margin of the poreplate in the three females examined (Fig. 20B, E, G), reaching the margin or surpassing it in six females illustrated by Xu *et al.* (2021: figs 5G-I, 6G-I, 7C, G-I). The CDO is mostly circular, small to

medium-sized (Fig. 20A, D, F), in some females longer than wide, elliptical or teardrop-shaped (Xu *et al*., 2021: figs 5D, F, 6D, 7F).

Relationships: Similarities in the shape of the vulval plate (anteriorly narrow posterior stalk; Fig. 20 cf. Fig. 18) and in the palpal organ (very wide distal edge of contrategulum, adpressed proximal edge of tegulum; Fig. 19A-B, D cf. Fig. 17A-D) suggest a fairly close relationship between *L. pyinoolwin* and *L. lordae*.

Distribution: This species is currently only known from the type locality near the western edge of the Shan Plateau (Fig. 1).

Biology: Most of the specimens examined were collected from earth banks at the bottom of a waterfall, a few on the sides of a trail. Most burrows were simple and undivided, closed by a single trapdoor; one burrow was Y-shaped and equipped with two doors close to each other; two burrows were sac-like, with two doors, built in the depression of a rock bolder, as know from cave-dwelling *Liphistius* species (see e.g. Klingel, 1967). Most burrows had 6-8 signal lines radiating from the entrance; only one had nine lines. The largest female had a 2.0 cm long and 2.9 wide trapdoor; penultimate males had 1.3-1.9 cm long and 2.1-2.8 cm wide trapdoors. Males matured between early September and late October, only a few months after being captured. No egg cases were found in the field in early July. Eggs are presumable laid in December, as it is the case in congeneric species in the mountains of northern Thailand (Schwendinger, 1990). In captivity large females moulted once per year, between September and October. One of the males carried parasitic mites of the genus *Ljunghia* (see Halliday & Juvara-Bals, 2016) which discarded their exuviae on the dorsal side of the spider opisthosoma (Fig. 2B). Another male fed on a cricket after reaching maturity, which is rather unusual because most adult *Liphistius* males stop feeding.

Liphistius cupreus Schwendinger & Huber, sp. nov.

Figs 1, 2D-I, 21-22

Holotype: MHNG-ARTO-0028341 (sample MT-14/21); male (matured 18.V.2017); Myanmar, Shan State, SE of Lashio, near Kong Nyaung Village (22°54'07"N, 97°47'27"E), 1130 m; 8.-9.VI.2014; leg. P.J. Schwendinger & S. Huber.

Paratypes: MHNG-ARTO-0028342 to MHNG-ARTO-0028347, BRCM (sample MT-14/21); 7 males (matured mid-VI.2015, two at end of VI.2015, 5.V.2016, 27.V.2016, 30.VI.2016, 1.VII.2016); collected together with the holotype. – MHNG-ARTO-0028349 to MHNG-ARTO-0028359, BRCM (sample MT-14/21); 12 females (allotype, MHNG-ARTO-0028349, last moulted 19.I.2019); collected together with the holotype.

Other material: MHNG; 2 small, badly preserved females, 1 juvenile; same data as for type specimens.

Etymology: The Latin adjective "cupreus" (= copper-coloured) refers to the colouration of the opisthosomal tergites in both sexes.

Diagnosis: Medium-sized spiders; both sexes with annulated legs (in females more distinct than in males) and without prefoveal setae. Most similar to *L. nabang* and *L. platnicki* sp. nov. by males sharing a distinctly elevated cumulus and a paracymbium with a distinctly conical distal side (Fig. 21A-B cf. Yu *et al*., 2021: fig. 3D-F and 23A-B); females sharing a similar vulval plate with more or less strongly reduced anterior poreplate lobes and with a short and wide posterior stalk widely connected to the popeplate (Fig. 22 cf. Yu *et al*., 2021: fig. 4 and Fig. 24). Males distinguished from those of *L. nabang* by tegulum lacking a distinctly elevated distal edge (Fig. 21K, M; present in *L. nabang*, Yu *et al*., 2021: fig. 3A-B, D-E) and having a widely rounded proximal edge (Fig. 21K; bent in *L. nabang*, giving the tegulum a triangular shape, Yu *et al*., 2021: fig. 3A); distal edge of contrategulum with an angular and finely dentate projection prodorsally (Fig. 21A, E-F, H-I; in *L. nabang* widely arched and not dentate, Yu *et al*., 2021: fig. 3B); paracymbium without a retrolateral-proximal heel (Fig. 21A cf. Yu *et al*., 2021: fig. 3E). Females distinguished from those of *L. nabang* by poreplates with 1-2 clusters of vesicles on each side of anterior margin (in *L. nabang* only 1) and without bulging posterolateral margins; posterior part of genital atrium not bent ventrad (Fig. 22 cf. Yu *et al*., 2021: fig. 4). Males distinguished from those of *L. platnicki* sp. nov. by tegulum lacking a distinctly elevated distal edge (Fig. 21K, M cf. Fig. 23I-M), proximal tegular edge only slightly protruding (Fig. 21J; strongly protruding in *L. platnicki* sp. nov., Fig. 23M); distal edge of contrategulum with an angular prodorsal projection (Fig. 21A, E-F, H-I; no projection in *L. platnicki* sp. nov., Fig. 23A, E-F). Females distinguished from those of *L. platnicki* sp. nov. by poreplate lacking anterolateral processes and by a relatively shorter posterior stalk (Fig. 22 cf. Fig. 24).

Description of male (holotype): *Colour in alcohol* (darker in life; as in Fig. 2D-F): Carapace with orange background colour and dark lateral and anterior margins; pars cephalica grey-brown except for a pair of light brown lateral marks and an unpaired light posteromedian mark; eye mound black; pars thoracica with irregularly shaped dark marks on coxal elevations and with a light brown posteromedian mark. Chelicerae cream-coloured proximally and prolaterally, grey-brown medially, light orange-coloured distally. Ventral side of palpal coxae and of sternum light orange-coloured, contrasting with slightly darker labium and leg coxae. Legs and palps mostly dark brown on dorsal side,

apart from distal half of tarsi I-II slightly lighter than proximal half and apart from an indistinct light median mark on leg tibiae; ventral side of legs with distinct light median mark on tibiae I-II and with an indistinct one on tibiae III-IV; ventral side of leg femora with distinct light median and proximal marks (remnants of annulations; see also Variation), plus scattered dark spots; ventral side of palpal tibia and femur light, with scattered dark spots; palpal tarsus and cheliceral claw dark reddish brown. Opisthosoma with light greyish brown membranous cuticle and with light orange-coloured sternites; tergite I entirely dark brown; tergite II mostly dark brown, with orange-coloured paramedian-posterior marks; tergites III-VII mostly light orange-coloured, with large dark marks, with a pair of dark paramedian-posterior marks and with scattered small dark spots; tergite VIII very small, entirely dark.

Setae on carapace: Few short setae (with wide gaps between them) on lateral margins; none on posterior margin; isolated setae on anterior coxal elevations, groups of 7-10 setae on posterior coxal elevations. No setae anterior to fovea.

Cheliceral teeth: 12 small teeth of different sizes on promargin of each cheliceral groove.

Scopula: Only distally divided by a median stripe on all tarsi; weak, posteriorly very thin and not clearly outlined in distal 4/5 of ventral side of leg tarsus I; equally thin and covering distal 5/6 of tarsus II; distinctly denser, more clearly outlined, covering 5/6 of tarsus III; equally dense and covering 4/5 of tarsus IV.

Tarsal claws: Paired claws with 4-5 teeth on tarsi I-III, 5 teeth on tarsus IV; unpaired claw of all leg tarsi without denticles.

Palp: Tibial apophysis short, triangular and basally wide in ventral view, not set back from distal margin of tibia (Fig. 21C), carrying 4 long apical megaspines, ventral 2 longer than dorsal 2; dorsal to apophysis a quite long spine on a slightly elevated base (Fig. 21C-D). Palpal tarsus with a pronounced subdistal suture on ventral side (Fig. 21A) and with a widely but shallowly invaginated distal margin (Fig. 21N). Paracymbium moderately deep (Fig. 21B), longer than wide, with a distinctly conical distal side and a widely arched retrolateral side in ventral view, lacking a retrolateral-proximal heel (Fig. 21A); cumulus quite large, distinctly elevated, carrying a densely packed group of about 10 long, strong bristles (Fig. 21A-B). Subtegulum without apophysis (Fig. 21A, M). Tegulum wide, axe-blade-shaped, its distal margin not elevated (Fig. 21M), its proximal edge short, widely rounded and finely dentate (see Fig. 21K showing paratype), only slightly bent and protruding, only little overhanging membranous contrategular area below it (Fig. 21J). Pigmented bridge between tegulum and contrategulum on retrodorsal side of palpal organ well developed (Fig. 21E, M). Contrategulum with moderately developed conical proventral process ending in a rounded apex in distal view (Fig. 21H-I); a few fine wrinkles on dorsal surface and a small proximal ledge on retrodorsal side (Fig. 21H, L-N, see also Fig. 21E-F for paratype); distal edge of contrategulum narrow, carrying a widely angular and finely dentate projection prodorsally (Fig. 21A, H-I, see also Fig. 21E-F for paratype), dorsal apex of contrategulum quite long and beak-like, very narrowly rounded (Fig. 21H-I, L, see also Fig. 21E-G for paratype). Para-embolic plate short, about as long as retroventral edge of embolus complex and not visibly separated from it by an invagination (Fig. 21A). Membranous prolateral-proximal zone of embolus complex distinctly swollen (Fig. 21A); embolus proper narrowly divided, its sclerotised part strengthened by 2 thick and 1 thin longitudinal ribs reaching apex and carrying denticles distally (Fig. 21A, M, see also Fig. 21E-F, K for paratypes); membranous part of embolus proper distinctly shorter than sclerotised part, at its base a short, proximally wide and weakly pigmented area with numerous longitudinal wrinkles and with a concave distal margin; embolic folds short (Fig. 21N).

Measurements: Total length 15.55; CL 6.03, CW 5.55; opisthosoma 6.90 long, 5.55 wide; eye mound 0.86 long, 0.97 wide; palpal coxa 2.02 long, 1.43 wide; labium 0.52 long, 1.15 wide; sternum 3.06 long, 2.14 wide (1.03 on ventral surface); palp 9.65 long (2.94 + 1.79 + 3.21 + 1.71); leg I 16.82 long (4.68 + 2.38 + 3.41 +4.29 + 2.06); leg II 17.85 long (4.68 + 2.42 + 3.57 + 4.88 + 2.30); leg III 20.16 long (5.00 + 2.54 + 3.89 + 5.95 + 2.78); leg IV 24.64 long (5.99 + 2.70 + 4.88 + 7.58 + 3.49).

Description of female (allotype): *Colour in alcohol* (darker in life, as in Fig. 2G-I): Mostly as in male, but generally slightly lighter (due to longer preservation in alcohol). Light distal area on chelicerae much smaller than in male and divided into a small median spot and a

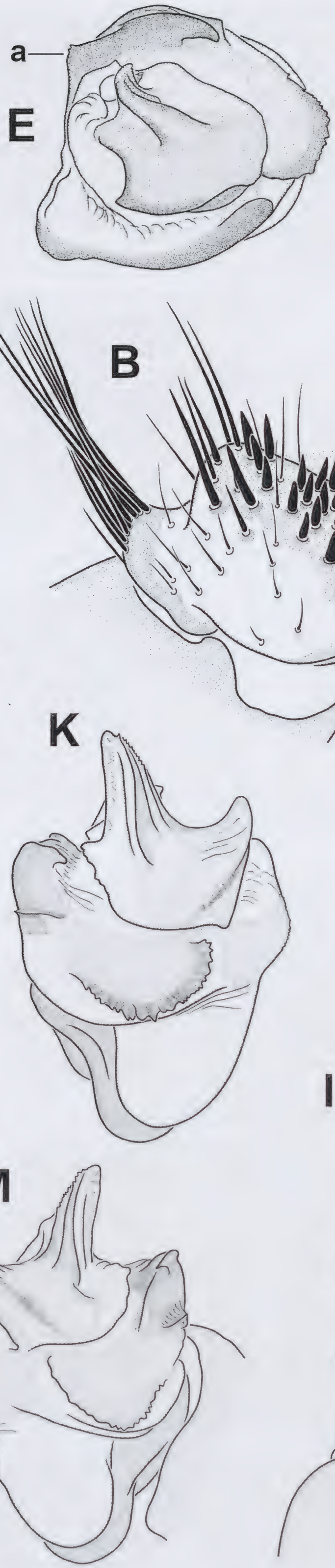
Fig. 21. *Liphistius cupreus* sp. nov., palps of three males; holotype (A-D, H-J, L-N), paratype matured end VI.2018 (E-G), paratype matured mid VI.2018 (K). (A) Left tarsus and palpal organ, ventral view. (B) Left paracymbium and distal margin of tibia, retrolateral view. (C) Distal part of left tibia, ventral view. (D) Same, retrolateral and slightly proximal view. (E) Left palpal organ, distal view (dorsal side up). (F) Dorsal part of left contrategulum and embolus proper, distal and slightly ventral view. (G) Dorsal part of left contrategulum, distal and slightly dorsal view. (H) Left contrategulum, distal and slightly ventral view. (I) Right contrategulum, same view. (J) Part of left palpal organ, retroventral view; slightly bent proximal edge of tegulum indicated by arrow. (K) Right palpal organ, retrolateral and slightly distal view. (L) Left palpal organ and distal margin of tarsus, dorsal and slightly proximal view. (M) Left palpal organ, retrolateral and slightly distal view. (N) Left palpal organ and distal margin of tarsus, prodorsal and slightly proximal view. Scale lines 1.0 mm (A-B, E-N; C-D). Abbreviation: a - angular prodorsal protrusion at base of distal edge of contrategulum.

A
a

C

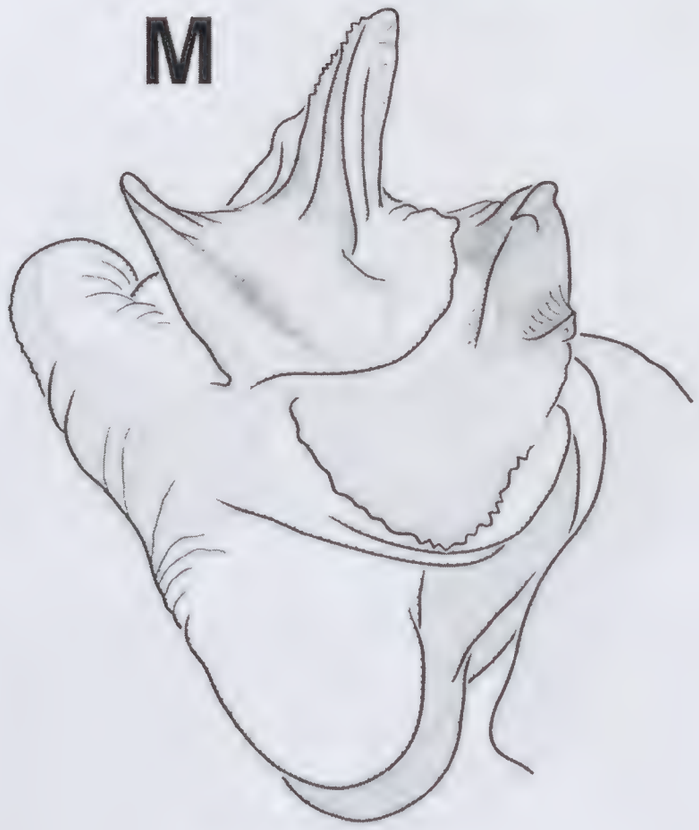
D

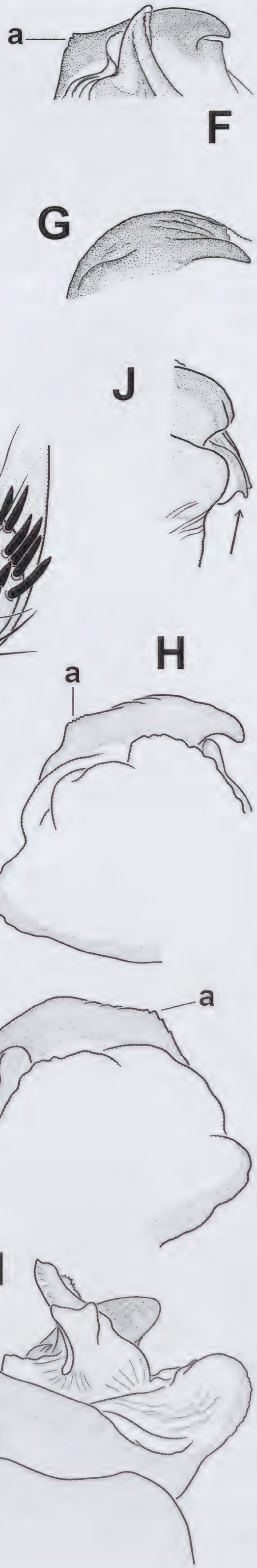
L
a


E
a

B

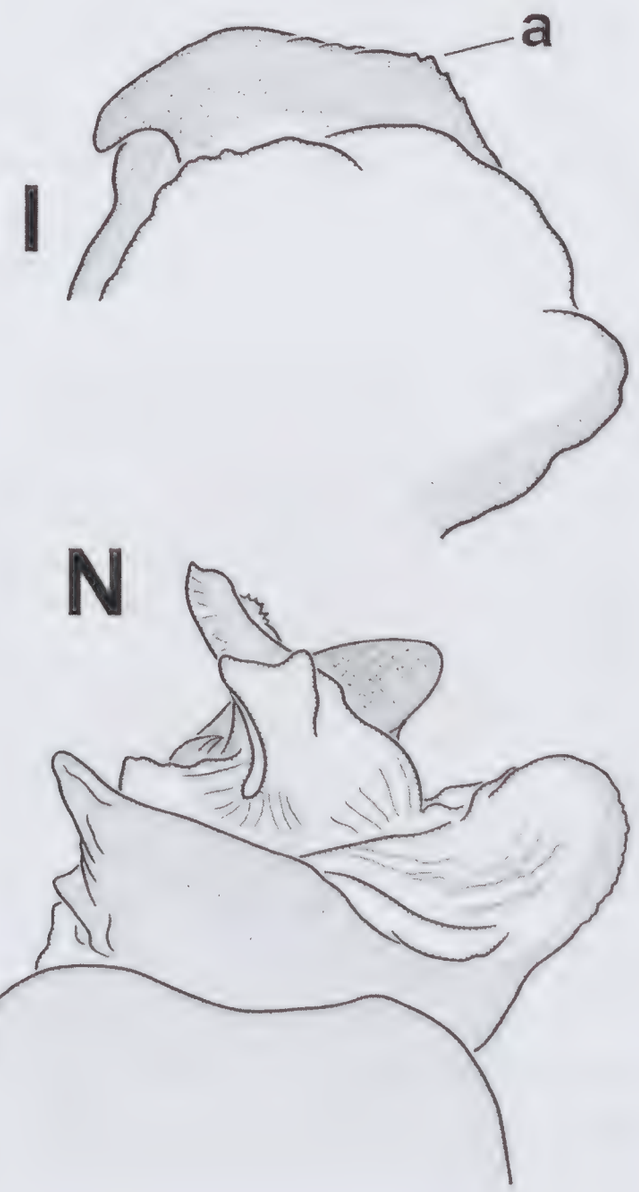
K


M


a
F
G

J

H
a


I
a

N

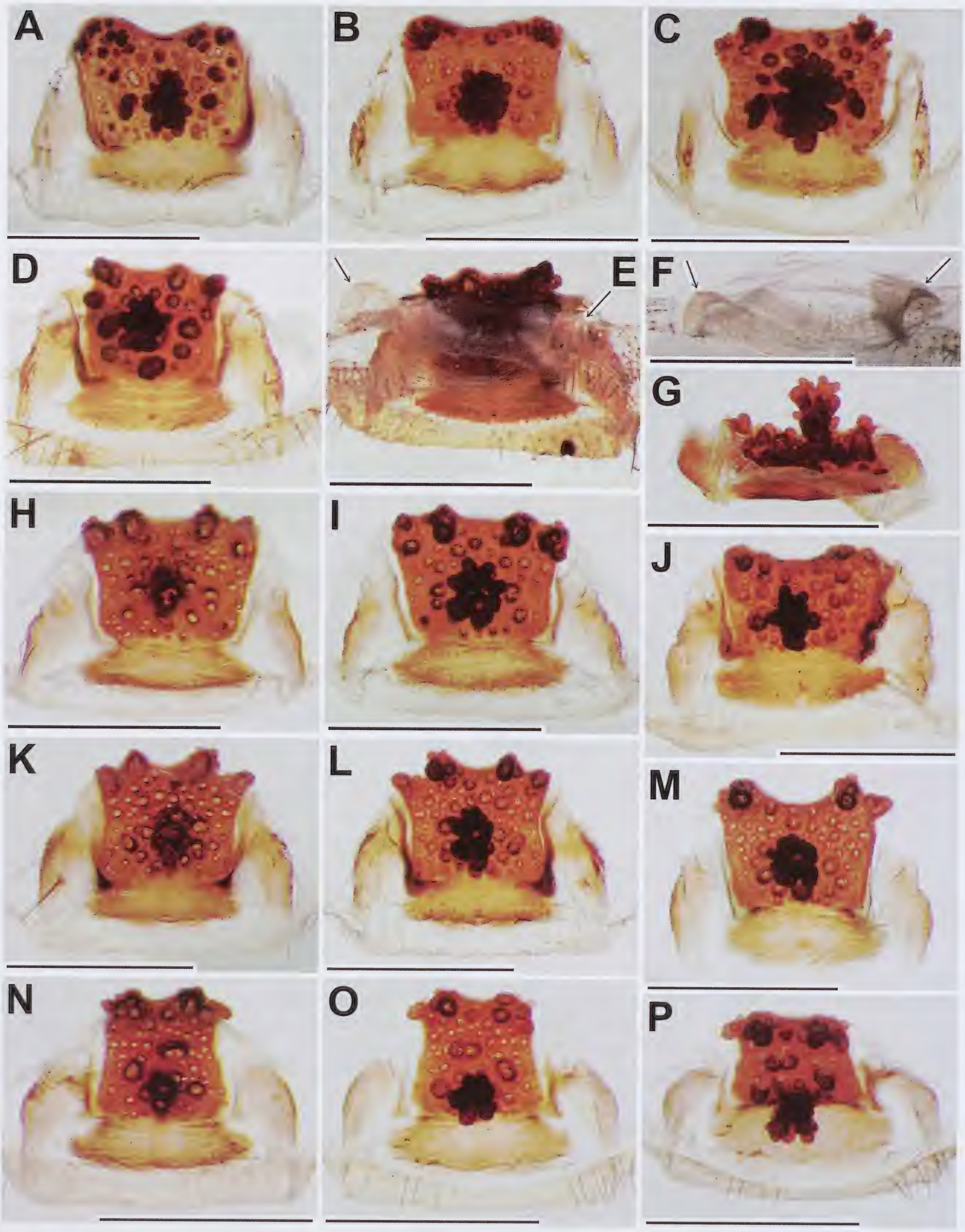


Fig. 22. *Liphistius cupreus* sp. nov., vulval plates of ten females (all taken from exuviae), dorsal view (E with uterus externus attached, H, K, N), ventral view (A-D, I-J, L-M, O), ventral and slightly anterior view (P), posterior view (G), and isolated uterus externus (F). (A) Moult of 10.II.2019. (B) Moult of 12.V.2020. (C) Moult of 5.VII.2019. (D-F) Moult of 22.XI.2020. (G) Moult of VI.2019. (H-I) Moult of 13.II.2021. (J) Allotype; moult of 19.I.2019. (K-L) Moult of 14.II.2021. (M) Moult of 1.V.2021. (N-P) Moult of 23.X.2021. Arrows indicating paired lateral pockets of membranous uterus externus. Scale lines 1.0 mm.

longitudinal retrodorsal stripe. Three light marks on pars cephalica and posteromedian light mark on pars thoracica of carapace less conspicuous. Palpal coxae darker than in males, almost of same colour as leg coxae I-II (leg coxae III-IV slightly lighter). Annulation of legs and palps more distinct than in males, clearly visible dorsally on all tibiae and on metatarsi III-IV, less clearly so on all femora and on tarsi III-IV. Distal 1/4 of palpal tarsus dark reddish brown.

Setae on carapace: Mostly as in male, but even fewer short setae on lateral margin; no setae anterior to fovea.

Cheliceral teeth: 11 strong teeth on promargin of right cheliceral groove; 11 strong teeth and 1 tiny denticle on left chelicera.

Claws: Palpal claws with 4 denticles each. Paired claws of legs I-II with 4 teeth, of leg III with 4-5 teeth, of leg IV with 5-6 teeth; unpaired claws of legs I-II with 1 denticle, of leg III with 0-1 denticle, of leg IV bare. All tarsi without scopulae.

Vulva (Fig. 22J): Membranous uterus externus with a distinct pair of lateral pockets (see Fig. 22E-F for another female). Vulval plate wider than long; only one hair on lateral fold of one side. Poreplate with widely but shallowly invaginated anterior margin carrying a single small process or cluster of vesicles (probably reduced anterior lobes) on one side and two small processes on other side, with inconspicuous lateral and posterior margins and with small CDO; receptacular cluster racemose but rather simple, longer than wide, not reaching anterior margin of poreplate, very deep (see Fig. 22G, P for other females). Posterior stalk short, as wide as poreplate, axe-blade-shaped, anteriorly only slightly narrower than posteriorly, with a widely arched posterior margin.

Measurements: Total length 20.08; CL 7.62, CW 6.90; opisthosoma 8.65 long, 6.35 wide; eye mound 0.98 long, 1.12 wide; palpal coxa 2.54 long, 1.79 wide; labium 0.63 long, 1.67 wide; sternum 4.37 long, 2.62 wide (1.39 on ventral surface); palp 12.39 long (4.05 + 2.38 + 3.02 + 2.94); leg I 15.91 long (5.04 + 2.78 + 3.25 + 3.25 + 1.59); leg II 16.59 long (5.04 + 2.90 + 3.25 + 3.57 + 1.83); leg III 18.49 long (5.16 + 3.06 + 3.49 + 4.48 + 2.30); leg IV 25.04 long (6.83 + 3.29 + 4.92 + 7.06 + 2.94).

Variation: For carapace measurements and prefoveal setae counts see Table 1. When still alive, at least one of the mature males examined showed light annulations on its leg femora, which are clearly visible not only on the ventral but also on the dorsal side (Fig. 2D, F); in alcohol these annulations are difficult to see. All specimens examined lack setae anterior to the fovea, and all specimens have both AME well developed. The extent of the scopulae differs among males: covering 3/4-5/6 of the ventral side of the leg tarsi (most often 4/5), rarely equally on all legs, in most specimens covering a larger portion on tarsi II-III that on tarsus I and tarsus IV. Variation in details of the male palp is given in Fig. 21. The angular prodorsal protrusion at the base of the distal contrategular edge is more or less prominent but always clearly visible (Fig. 21A, E-F, H-I, L). The proventral contrategular process in distal view is asymmetrically conical on the right palp of the holotype (Fig. 21I). Three male paratypes have a short subdistal ridge at the distoventral corner of their tegulum (Fig. 21K), which is very different in shape from but presumably homologous to the elevated distal tegular edge in *L. nabang* and *L. platnicki* sp. nov. (Yu *et al*., 2021: fig. 3A-B, D-E and Fig. 23I-M). All males examined have: three ridges (two thick and one thin) reaching the apex of the sclerotised embolus part; a swollen membranous area prolaterally-proximally on the embolus complex; a beak-like dorsal apex of the distal contrategular edge; a rather indistinct proximal ledge on the retrodorsal side of the contrategulum; a short and only slightly bent proximal tegular edge. In the largest female (the allotype) the annulation (a light median ring) of metatarsi I-II is completely broken on the dorsal side (being entirely dark); in medium-sized females there are small light spots on the dorsal side of metatarsi I-II (i.e. a partially broken annulation); in smaller females the annulation of metatarsi I-II is entire, as it is on metatarsi III-IV and on all tibiae. Variation in the shape of the vulval plate is considerable (Fig. 22): the anterior poreplate margin bears one or two small processes on each side (often different numbers on both sides; these are probably reduced anterior lobes, as indicated by only little reduced lobes in two females, Fig. 22A-B); the CDO is in the centre of the poreplate (Fig. 22H) or distinctly posterior to it (Fig. 22N); the shape of the receptacular cluster ranges from fairly small and simple (Fig. 22O) to quite large and complex (Fig. 22C), but it never reaches the anterior margin of the poreplate; most vulval plates have no hairs on their lateral folds, if present, there are only 1-2 and usually only on one side, in one specimen one of these hairs is unusually thick (Fig. 22K).

Relationships and biogeography: *Liphistius cupreus* sp. nov. is very similar and presumably most closely related to *L. nabang*. Considering how far the localities of both nominal species are apart, it is very unlikely that they are actually conspecific. All species in the *birmanicus*-group appear to have quite small geographical ranges. In *Liphistius* it is generally large-sized species in the lowlands (e.g. *L. yangae* Platnick & Sedgwick, 1984; see Schwendinger *et al*., 2019: 333, fig. 2) that are known to have relatively large geographical ranges, not small or medium-sized species in the mountains. The type locality of *L. nabang* lies about 190 km north of that of *L. cupreus* sp. nov. (both in the mountains of the Shan-Yunnan Plateau), whereas the morphologically less similar but geographically much closer *L. platnicki* sp. nov. was found only 17 km north of the type locality of *L. cupreus* sp.

nov. (Fig. 1). These three species form a well-defined subgroup within the *bristowei*-group (see Discussion - Relationships).

Biology: The spiders were found on earth banks on the side of a rural road and on the sides of a stream in a disturbed evergreen hill forest. All burrows were closed by a single trapdoor and had up to eight signal lines attached to the entrance. Penultimate males had the front door 1.45-1.9 cm long and 2.2-2.5 cm wide. The largest female had a 2.1 cm long and 2.9 cm wide door. Males matured in captivity between mid and end-June in the first year after capture (on June 8 and 9), between early May and the beginning of July in the second year, and in late May of the third year. The mating period in nature appears to be in May to June; possibly even much earlier, as indicated by the find of 3rd instar spiderlings in the burrow of a female when it was captured in early June. In captivity another female built an egg case, 2.8 cm long, 3.0 cm wide and 2.0 cm high, containing 39 light yellow eggs suspended on a layer of fine silk, about 2.5 months after being captured. Mature females usually moulted twice per year: between November and March and again between May and July. The female that built an egg case subsequently moulted in December.

Liphistius platnicki Schwendinger & Huber, sp. nov.

Figs 1, 2C, 23-24

Holotype: MHNG-ARTO-0028361 (sample MT-14/25); male (matured 1.VIII.2016); Myanmar, Shan State, N of Lashio, near Loi Kan Village (23°05'23"N, 97°47'02"E), 1140 m; 10.VI.2014; leg. P.J. Schwendinger & S. Huber.

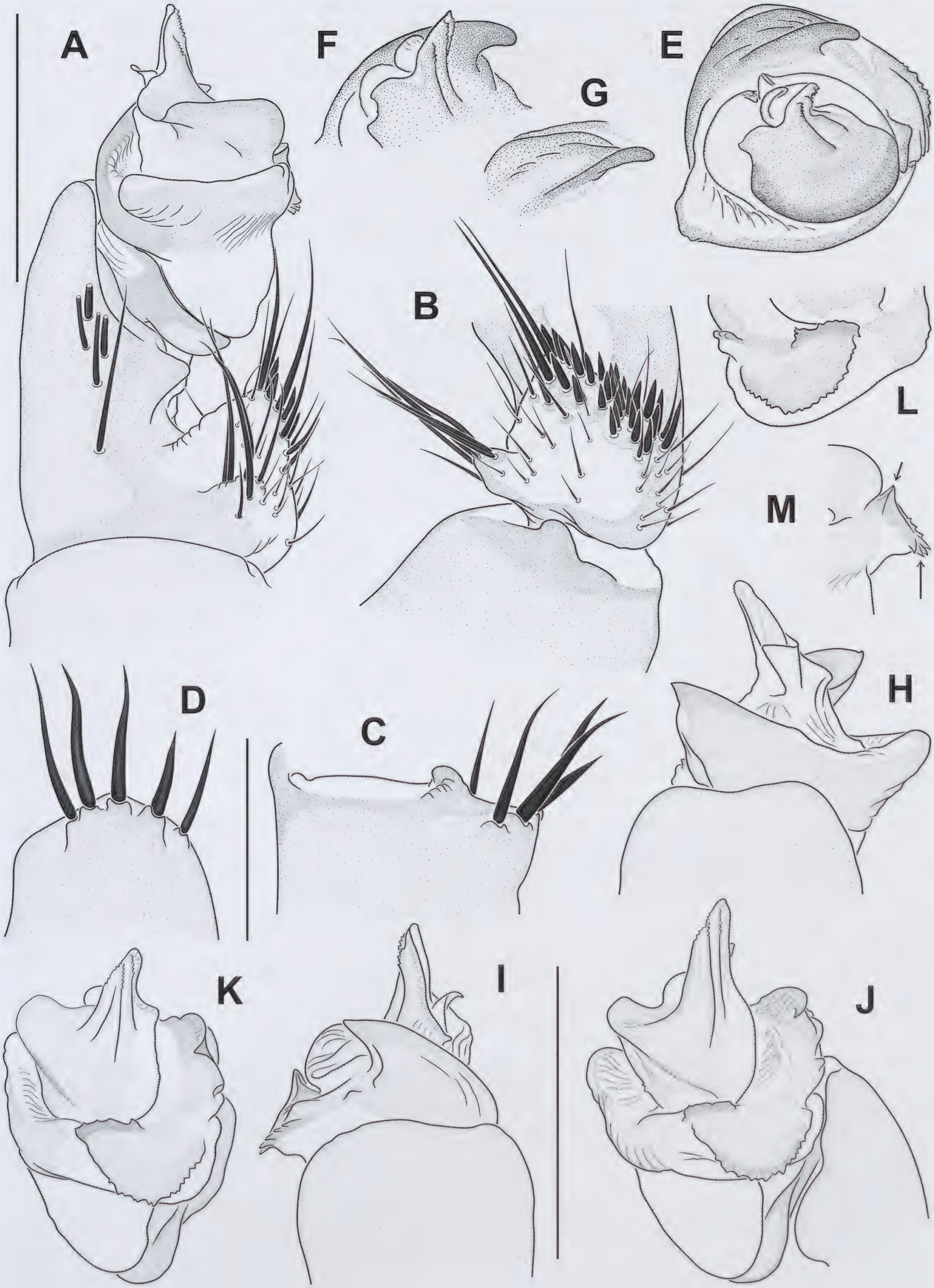
Paratypes: MHNG-ARTO-0028362 to MHNG-ARTO-0028366, BRCM (sample MT-14/25); 6 males (matured 10.IX.2015; 26.V.2016; 2.VII.2016; 3.VII.2016; 26.VII.2016; 8.VIII.2016); collected together with the holotype. – BRCM, MHNG-ARTO-0028369 to MHNG-ARTO-0028377 (sample MT-14/25); 10 female paratypes (allotype, MHNG-ARTO-0028377, last moulted 10.III.2021); collected together with the holotype.

Etymology: We name this species in honour of the renowned American arachnologist Norman I. Platnick (1951-2020) who, together with Walter C. Sedgwick, revised and properly defined the genus *Liphistius* in 1984 and described several species (also from Myanmar) in this genus. Initially we wanted to name after him the species that he misidentified as *L. birmanicus* and that he described and illustrated from both sexes in much detail, but that meanwhile was named *L. pyinoolwin* in 2021.

Diagnosis: Medium-sized, mostly brown species with indistinctly annulated legs in females (but not in males). Most similar to *L. nabang*. Males different by distal contrategular edge in distal view without a prodorsal protrusion (Fig. 23A, E-F, I; present in *L. nabang*, Yu *et al.*, 2021: fig. 3B) and with a narrowly rounded apex (Fig. 23E-G; pointed in *L. nabang*, Yu *et al.*, 2021: fig. 3B); proximal edge of tegulum widely rounded (Fig. 23J-L; angular in *L. nabang*, Yu *et al.*, 2021: fig. 3A); paracymbium without retrolateral-proximal heel (Fig. 23A; present in *L. nabang*, Yu *et al.*, 2021: fig. 3E). Females distinguished from those of *L. nabang* by poreplate anteriorly wider than posteriorly (in *L. nabang* anteriorly narrower than posteriorly or equally wide), its anterior margin more strongly invaginated (in *L. nabang* slightly invaginated to arched); posterior stalk relatively longer and slightly constricted in anterior portion, without "bulging margins" between poreplate and posterior stalk (in *L. nabang* transition between poreplate and posterior stalk very wide and carrying widely separated "bulging margins"); posterior part of genital atrium not strongly curved ventrad (Fig. 24 cf. Yu *et al.*, 2021: fig. 4).

Description of male (holotype): *Colour in alcohol* (darker in life): Mostly light brown. Carapace with slightly darkened, large, orchid-shaped pattern on pars thoracica; eye mound black. Chelicerae cream-coloured proximally, light brown distally. Ventral side of palps and legs slightly lighter than dorsal side; most of ventral side of palpal coxae and leg tarsi cream-coloured. Legs and palps mostly light brown, without annulations; palpal tarsus and sclerotised parts of palpal organ dark brown. Membranous cuticle of opisthosoma cream-coloured and finely mottled with grey. Sternites of opisthosoma slightly darker than membranous cuticle; tergite I entirely dark brown, tergites II-VI mostly light yellow-brown, with darker spots laterally and on

Fig. 23. *Liphistius platnicki* sp. nov., palps of three males; holotype (A-D, H-J, M), paratype matured 26.VII.2019 (E-G), paratype matured 8.VIII.2016 (K-L). (A) Left tarsus and palpal organ, ventral view. (B) Left paracymbium and distal margin of tibia, retrolateral view. (C) Distal part of left tibia, ventral view. (D) Same, retrolateral and slightly proximal view. (E) Left palpal organ, distal view (dorsal side up). (F) Dorsal part of left contrategulum and embolus proper, distal and slightly ventral view. (G) Dorsal part of left contrategulum, distal and slightly dorsal view. (H) Left palpal organ and distal margin of tarsus, prodorsal and slightly proximal view. (I) Same, dorsal and slightly proximal view. (J) Same, retrolateral and slightly distal view. (K) Left palpal organ, retrolateral view. (L) Tegulum and nearby parts of right palpal organ, same view. (M) Part of left palpal organ, retroventral view; elevated distal edge of tegulum indicated by short arrow, straight, salient proximal tegular edge indicated by long arrow. Scale lines 1.0 mm (A-B; C-D; E-M).


A
F
G
E
B
L
M
H
D
C
K
I
J

posterior margin, tergites VII-X light yellow-brown medially and dark brown laterally.
Setae on carapace: Several small setae around eye mound, including one closely spaced enlarged pair side by side behind eye mound; few small setae on lateral margins of carapace and on coxal elevations; 1 enlarged seta on each posterolateral corner; no setae on posterior margin; 2 small setae anterior to fovea.
Cheliceral teeth: 12 small teeth of different sizes on promargin of each cheliceral groove.
Scopula: Only distally divided by median stripe on all tarsi; quite weak on tarsus I, only slightly denser on other tarsi; covering distal 5/6 of tarsi I-III, distal 4/5 of tarsus IV.
Tarsal claws: Paired claws with 3 teeth on tarsus I, 3-4 on tarsus II, 4 on tarsus III, 5-6 on tarsus IV; unpaired claw with 1-2 (mostly 2) denticles on tarsi I-III, 1 and 3 on tarsus IV.
Palp: Tibial apophysis short, triangular and basally wide in ventral view, not set back from distal margin of tibia (Fig. 23C), carrying 4 long apical megaspines, the ventral 3 distinctly longer than the dorsal one; dorsal to apophysis a quite long spine on a slightly elevated base (Fig. 23C-D). Palpal tarsus with a pronounced subdistal suture on ventral side (Fig. 23A) and with a widely but shallowly invaginated distal margin (Fig. 23H-I). Paracymbium moderately deep (Fig. 23B), in ventral view clearly longer than wide, with a distinctly conical distal side, without a retrolateral-proximal heel (Fig. 23A); cumulus distinctly elevated, unpigmented on its retroventral side, carrying a group of 5 long, strong bristles (Fig. 23A-B). Subtegulum without apophysis (Fig. 23A, J). Tegulum wide, axe-blade-shaped; its distal margin elevated, developed as a short, wide keel with a quite straight margin (Fig. 23I-J, M); its proximal edge widely rounded and finely dentate, straight (not bent proximad) and strongly protruding from surface of palpal organ (Fig. 23I-J, M). Pigmented bridge between tegulum and contrategulum on retrodorsal side of palpal organ well developed (Fig. 23J). Contrategulum with moderately developed, conical proventral process (Fig. 23E, showing paratype); essentially only a single strong wrinkle on prolateral surface and a very indistinct proximal ledge on retrodorsal side (Fig. 23H-J, see also Fig. 23F, K for paratype); distal edge of contrategulum narrow and evenly arched, without protrusion prodorsally; dorsal apex of contrategulum quite long and very narrowly rounded (Fig. 23I, see also Fig. 23E-G for paratype). Para-embolic plate short, about as long as retroventral edge of embolus complex and not clearly separated from it by an invagination (Fig. 23A). Membranous prolateral-proximal zone of embolus complex not swollen (Fig. 23 A; swollen in *L. cupreus* sp. nov., Fig. 21A); embolus proper narrowly divided, its sclerotised part strengthened by 3 longitudinal ribs reaching apex and carrying denticles distally (Fig. 23J, see also Fig. 23E-F, K for paratypes); membranous part of embolus proper distinctly shorter than sclerotised part, at its base a short, weakly pigmented area with only a few longitudinal wrinkles and with a very narrow and concave distal margin; embolic folds short (Fig. 23H).
Measurements: Total length 13.12; CL 5.45, CW 4.93; opisthosoma 5.56 long, 3.82 wide; eye mound 0.90 long, 0.96 wide; palpal coxa 1.91 long, 1.19 wide; labium 0.40 long, 0.95 wide; sternum 2.70 long, 1.91 wide (0.95 on ventral surface); palp 9.14 long (2.74 + 1.67 + 3.18 + 1.55); leg I 16.10 long (4.41 + 2.23 + 3.34 +3.97 + 2.15); leg II 17.01 long (4.45 + 2.23 + 3.46 + 4.49 + 2.38); leg III 19.12 long (4.77 + 2.23 + 3.78 + 5.52 + 2.82); leg IV 23.48 long (5.80 + 2.38 + 4.77 + 7.03 + 3.50).

Description of female (allotype): *Colour in alcohol* (darker in life, as in Fig. 2C): Mostly as in male, but generally darker, distal part of chelicerae much darker. Legs and palps with indistinct annulations, i.e. faint and broken light median rings on all tibiae of legs and palps, plus on metararsi of legs II-IV, and very faint on tarsi II-IV; a faint light proximal ring on all leg metatarsi. Membranous cuticle of opisthosoma more distinctly mottled with grey-brown than in male; tergites II-VI with much larger dark portions, extending from anterior to posterior margins, leaving rather small paramedian pairs of longitudinal bands.
Setae on carapace: Slightly more than in the holotype; pair of stiff bristles in front of eye mound much larger; pair of enlarged setae behind eye mound situated behind each other (in male side by side); 5 small setae anterior to fovea.
Cheliceral teeth: 12 strong teeth on promargin of each cheliceral groove.
Claws: Left palpal claw with 2 denticles, right claw with 3 denticles. Paired tarsal claws of legs I-II with 3 teeth, of leg III with 4 teeth, of leg IV with 3-4 teeth; unpaired claws of leg I with 3 denticles, of leg II with 3-4 denticles, of leg III with 2 denticles, of leg IV with 1-2 denticles. All tarsi without scopula.
Vulva (Fig. 24C, F): Membranous uterus externus with a small but distinct pair of lateral pockets (see Fig. 24G for another female). Vulval plate slightly longer than wide, with a few hairs on lateral folds. Poreplate with widely and quite deeply invaginated anterior margin carrying a

Fig. 24. *Liphistius platnicki* sp. nov., vulval plates of ten females (all from exuviae), dorsal view (A, D, K, O), ventral view (B-C, E, H-J, L-N, P), anterior view (F), and isolated uterus externus (G). (A-B) Moult of 29.I.2021. (C, F) Moult of 10.III.2021 (allotype). (D-E) Moult of 25.IV.2020. (G, N) Moult of 14.X.2021. (H) Moult of 14.V.2020. (I) Moult of 20.XI.2021. (J) Moult of 13.X.2021. (K-L) Moult of 2.IV.2021. (M) Moult of 7.I.2021. (O-P) Moult of 3.X.2021. Arrows indicating paired lateral pockets of membranous uterus externus. Scale lines 1.0 mm.

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P

fairly large and widely separated pair of vesicle clusters (corresponding to anterior lobes); anterolateral processes on each side of poreplate small, composed of only one vesicle (on one side) or a few vesicles (on other side). CDO small; receptacular cluster racemose, slightly longer than wide, not reaching anterior margin of poreplate, very deep (Fig. 24F). Posterior stalk quite long, wider than poreplate, with a slight constriction at transition from poreplate to posterior stalk; axe-blade-shaped, anteriorly narrower than posteriorly, with a widely arched posterior margin (Fig. 24C).

Measurements: Total length 18.56; CL 6.68, CW 5.84; opisthosoma 8.62 long, 6.92 wide; eye mound 0.97 long, 1.00 wide; palpal coxa 2.42 long, 1.55 wide; labium 0.64 long, 1.55 wide; sternum 3.54 long, 2.34 wide (1.43 on ventral surface); palp 10.61 long (3.38 + 2.03 + 2.54 + 2.66); leg I 13.59 long (4.21 + 2.42 + 2.74 + 2.70 + 1.52); leg II 14.06 long (4.21 + 2.46 + 2.74 + 2.98 + 1.67); leg III 15.30 long (4.25 + 2.54 + 2.94 + 3.66 + 1.91); leg IV 21.09 long (5.68 + 2.82 + 4.17 + 5.76 + 2.66).

Variation: For carapace measurements and prefoveal setae counts see Table 1. All specimens have both AME well developed. In four specimens the prefoveal setae are situated relatively far away from the fovea. Most females have two enlarged bristles behind the eye mound, one specimen has only one. In most males the scopula covers 5/6 of the ventral side of tarsi I-III and 4/5 of tarsus IV, in one male it covers 4/5 of tarsus I. Variation in details of the male palp is given in Fig. 23. None of the males has a prodorsal protrusion at the base of the distal contrategular edge (present in *L. nabang* and *L. cupreus* sp. nov.). The apex of the proventral contrategular process is narrowly rounded or obliquely truncate (Fig. 23E) in distal view. All males have a distinctly elevated distal tegular edge which is dentate (Fig. 23K-L) or quite smooth (Fig. 23J). All males examined have three ridges reaching the apex of the sclerotised embolus part. The lightly pigmented area at the base of the membranous embolus part has wrinkles that are more or less strongly inclined, in some specimens being almost horizontal. In small females the annulations (light median rings) on the legs and palps are more pronounced than in the allotype (the largest female examined). Variation in the shape of the vulval plate is shown in Fig. 24: the lateral folds carry no or only very few hairs; the anterior margin of the poreplate is slightly to deeply invaginated, widely concave to straight; the anterior lobes (vesicle clusters) are narrow to wide; the anterolateral processes are small and composed of one to only a few vesicles; the receptacular cluster is small to medium-sized, always racemose, never reaching the anterior poreplate margin; the posterior stalk is axe-blade-shaped to almost elliptical.

Relationships: The new species appears most closely related to *L. nabang* + *L. cupreus* sp. nov. with which it shares characters explained further below (see Discussion - Relationships). These three species form the most distinct subgroup within the *birmanicus*-group.

Distribution: This species is only known from the type locality near Lashio, about 17 km north of the type locality of *L. cupreus* sp. nov. (Fig. 1).

Biology: No mature spiders and no egg cases were found at the type locality, but the dates at which males matured in captivity (especially the first date after capture) indicate that this species has a phenology very similar to other congeneric species in Myanmar and northern Thailand.

Table 1. Carapace measurements (in mm; including data from the literature) and prefoveal setae counts of *Liphistius birmanicus* group species.

Liphistius	N of males	CL in males	CW in males	Prefoveal setae in males	N of females	CL in females	CW in females	Prefoveal setae in females
lahu	2	6.0-6.3	5.5-5.9	3-6	7	6.3-8.0	5.3-7.3	9-13
metopiae sp. nov.	2	6.03-6.19	5.44-5.50	0-4	5	7.48-8.37	6.73-7.43	2-10
tung sp. nov.	2	6.30-6.70	5.70-6.26	9-10	6	up to 7.42	up to 6.62	11-24
ferox sp. nov.	6	11.47-12.67	10.45-11.47	0-2	18	up to 18.32	16.61	0-22 (mostly 0-7)
birmanicus	8	7.79-9.50	7.29-9.45	11-25	22	6.41-14.73	5.45-13.27	over 40
hpruso					2	up to 7.02	up to 6.16	?
pinlaung	12	4.92-6.54	4.56-6.34	0-4	15	up to 7.62	up to 6.66	7-14
lordae	2	6.3-6.5	5.9-6.1	2-4	4	7.3-8.5	6.2-7.9	13-22
pyinoolwin	20	4.23-7.48	4.87-7.13	9-14	18	up to 8.42	up to 7.87	24-28
cupreus sp. nov.	8	5.67-6.11	5.00-5.63	0	12	up to 7.70	up to 6.90	0
platnicki sp. nov.	7	5.21-6.21	4.82-5.77	1-4	10	up to 6.68	up to 5.84	3-5
nabang	2	up to 4.89	up to 5.11	0?	3	up to 7.48	up to 6.52	0?

Liphistius nabang Yu, Zhang & Zhang, 2021

Liphistius nabang Yu, Zhang & Zhang, 2021: 36-40, figs 1-4 (description of males and females).

Types: MHBU-ARA-00020000 to MHBU-ARA-00020004; male holotype, 1 male and 3 female paratypes; China, Yunnan Province, Yingjiang County, Nabang (24°45'07.64"N, 97°33'47.02"E and 24°45'27.13"N, 97°33'52.86"E), 265-283 m; 2.VIII.2019 and 2.X.2019; leg. Q. Ji and K. Yu, C. Zhang & S.Y. Zhang. Types not examined; no additional material available.

Diagnosis: Distinguished by the following combination of characters: tegulum somewhat triangular in shape, with distinctly elevated distal edge and V-shaped proximal edge; distal contrategular edge with widely rounded prodorsal protrusion and pointed apex; paracymbium with retrolateral-proximal heel; cumulus distinctly elevated (Yu *et al.*, 2021: fig. 3); vulval plate strongly bent ventrad in proximal part; poreplate with reduced anterior lobes and without anterolateral processes; posterior stalk short, wider than poreplate; a pair of lateral "bulging margins" between poreplate and posterior stalk (Yu *et al.*, 2021: fig. 4).

Additions to description and taxonomic remarks: This species is most similar and probably very closely related to *L. cupreus* sp. nov. and *L. platnicki* sp. nov., which are also geographically the closest congeners. *Liphistius nabang* shares with these two species a number of characters which are taxonomically more or less important. These are: an enlarged spine on an elevated base dorsal of the tibial apophysis (Yu *et al.*, 2021: fig. 3D; Figs 21C-D, 23C-D), a relatively long and narrow paracymbium with a distinctly conical distal side and a distinctly elevated cumulus (Yu *et al.*, 2021: fig. 3D-F; Fig. 21A-B; Fig. 23A-B), a more or less distinctly elevated distal edge of the tegulum (Yu *et al.*, 2021: fig. 3A-B, D-E; Fig. 21K; Fig. 23I-M; absent in some males of *L. cupreus* sp. nov., Fig. 21M) and a reduced proximal ledge on the dorsal side of the contrategulum (Yu *et al.*, 2021: fig. 3A-B; Figs 21E-F, H-I, K-N, 23F, I-K) in males, plus a similar vulval plate with more or less strongly reduced anterior poreplate lobes and with a wide (at least as wide as poreplate) posterior stalk in females (Yu *et al.*, 2021: fig. 4; Figs 22, 24). It is not clear from the original description and illustrations if *L. nabang* also shares with these two new species a pronounced subdistal suture on the ventral side of the palpal tarsus. *Liphistius nabang* differs from these two similar species by possessing a rather triangular tegulum (Yu *et al.*, 2021: fig. 3A cf. Figs 21K, 23J-L) and a retrolateral-proximal heel on the paracymbium (Yu *et al.*, 2021: fig. 3E; absent in *L. cupreus* and *L. platnicki* sp. nov., Figs 21A, 23A) in males, as well as by a wider posterior stalk and a shallowly invaginated or slightly arched distal poreplate margin (instead of always invaginated, in most cases more deeply so than on *L. nabang*) (Yu *et al.*, 2021: fig. 4 cf. Figs 22, 24). The widely separated lateral pair of "bulging margins" of *L. nabang*, situated on the ventral side of the vulval plate between the poreplate and the posterior stalk (Yu *et al.*, 2021: fig. 4), is a structure that we have not observed in any other congeners and which appears to be autapomorphic. We assume that these "bulging margins" are exceptionally widely separated, thickened posterior poreplate margins.

CL and CW of the male holotype are given as 4.89 and 5.11 (Yu *et al.*, 2021: 37; no measurements are given for the male paratype), which suggests that this structure is wider than long, something we have not observed in any other *Liphistius* species. This odd ratio is not evident from the corresponding photo (Yu *et al.*, 2021: fig. 2A), where the carapace looks clearly longer than wide. If measured in a position with the anterior and posterior carapace margin at the same focal plane, the measurements are probably different.

Although not mentioned in the original description of *L. nabang*, photos of the male holotype and of a female paratype therein (Yu *et al.*, 2021: fig. 2A-B) indicate that prefoveal setae are missing in both sexes. Within the *birmanicus*-group this unusual lack (if confirmed) is only shared with the closely related *L. cupreus* sp. nov.

Variation: See Yu *et al.*, 2021: 37, 40. For carapace measurements see Table 1.

Distribution: This species is known only from the type locality, which lies at low altitudes right at the border between the Yunnan Province of China and the Kachin State of Myanmar. It presumably occurs on both sides of the border.

DISCUSSION

New character: The lateral pockets of the membranous uterus externus of *Liphistius* females have previously been overlooked. They are best visible on exuviae; in entire specimens the uterus externus usually gets removed or destroyed during dissection. These pockets are quite pronounced and well visible in large species like *L. ferox* sp. nov. and *L. birmanicus* (see Figs 11I-J, N, P, 12D, F, 14D), whereas in smaller species like *L. lahu*, *L. cupreus* sp. nov. (Fig. 22E-F) and *L. platnicki* sp. nov. (Fig. 24G) they are rather small or indistinct. These pockets are presumably present in all species of the *birmanicus*-group. They also were found in *L. marginatus* Schwendinger, 1990 (*bristowei*-group), *L. ornatus* Ono & Schwendinger, 1990 (*trang*-group) and *L. malayanus* Abraham, 1923 (*malayanus*-group) and thus probably are part of the groundplan of female genitalia in *Liphistius*. This character appears to be of only minor taxonomic value on the species level, and its function is unclear. Under a compound microscope numerous tiny pores can

be seen in the membranous dorsal and ventral walls of the uterus externus between these pockets, but not in the the walls of the pockets themselves. Through these pores presumably glands empty into the uterus externus (as other glands empty into the vulva through pores in the poreplate; Schwendinger & Ono, 2011: figs 59-64) and keep sperm that the female receives during copulation viable (or flush it out?). Thus in *Liphistius* the entire vulva, not only its receptacular cluster and vesicles, is a spermstoring organ. However, it is surprising that there are no pores in the walls of the lateral pockets.

Relationships: Some similarities in male and female copulatory organs (narrowly divided embolus proper, unpigmented retrolateral margin of embolus complex) and geographic proximity indicate a close relationship between the *birmanicus*-group and the *bristowei*-group. The geographical ranges of both groups are very close to each other, and there is even evidence for co-occurrence (see below). The *trang*-group is currently known to be geographically separated from the *birmanicus*-group by about 600 km (the distance between localities of *L. ferox* sp. nov. in eastern Myanmar and *L. erawan* Schwendinger, 1996 in western Thailand). Clear differences in genital morphology, especially the widely divided embolus proper in *trang*-group males (see Schwendinger, 1990: figs 60-62, Schwendinger, 2017: fig. 3A, C, E, G), do not suggest a close phylogenetic relationship between the *birmanicus*-group and the *trang*-group. The remaining currently recognized species groups (*malayanus*-, *tioman*-, *linang*-, *batuensis*-group; Schwendinger, 2017) all occur far from the geographical range of the *birmanicus*-group, in Peninsular Malaysia or on the Thai side of the Thai-Malaysian border. Little in the genital morphology of these species indicates a close relationship with *birmanicus*-group species. Among the few characters they have in common are the presence of anterior lobes on the poreplates of some species, and a quite short major embolic fold between the sclerotised and the membranous part of the embolus proper. The major embolic fold is long in *bristowei*-group males (see e.g. Schwendinger, 1990: figs 57-59) and it is a diagnostic character for that species group. Of course, this morphology-based interpretation needs to be confirmed by molecular data.

Within the *birmanicus*-group we can distinguish four more or less clearly defined subgroups on the basis of morphological characters. 1) The three northernmost species (*L. cupreus* sp. nov., *L. platnicki* sp. nov. and *L. nabang*) share a posterior stalk that is as wide or wider than the poreplate, and more or less strongly reduced anterior lobes on the poreplate in females, as well as five genital characters in males [i.e. a relatively long and narrow apex of the distal contrategular edge, a more or less distinctly elevated distal tegular edge (indistinct or absent in *L. cupreus* sp. nov.), a distinctly elevated cumulus, a relatively long paracymbium with a distinctly conical distal side, a quite strong spine on an elevated base dorsal of the tibial apophysis; Figs 21, 23, Yu *et al.*, 2021: fig. 3] that are not found in other species of this group. These three species thus form a quite well-defined subgroup. 2) *Liphistius birmanicus* and *L. pinlaung* occur close to each other and share a peculiar and probably synapomorphic distad-directed proventral contrategular process (Figs 13D, F, 15C, E; this is inclined at an angle of about 45-90° from the axis of the palpal organ in all other congeners, e.g. Fig. 4G); their female genitalia are also quite similar to each other, having anterolateral processes on the poreplate and an axe-blade-shaped posterior stalk (Figs 14, 16). The male of *L. hpruso* is unknown, but close geographical proximity, a similar vulval plate and a body colouration similar to that of *L. birmanicus* suggest that *L. hpruso* also belongs to this quite well-defined subgroup. 3) *Liphistius lahu* and *L. metopiae* sp. nov. in Thailand have very similar male palps (Figs 4, 6), but their female genitalia are more distinct [*L. metopiae* sp. nov. with anterolateral processes (Fig. 7), *L. lahu* without (Fig. 5)]. We consider these two species to be closest relatives. 4) *Liphistius tung* sp. nov. and *L. ferox* sp. nov. share a long, tongue-shaped para-embolic plate (Figs 8A, H-I, 10A-D), which is very short in all other species of the group. However, the localities of both species are far apart, and these species have otherwise little else in common that is relevant. Either the similarities in the para-embolic plate of both species are due to homoplasy, or there are yet unknown species that provide a link. 5) The remaining two species, *L. lordae* and *L. pyinoolwin*, are geographically fairly close to each other (Fig. 1). Males of both species have an adpressed proximal tegular margin (Figs 17D, 19D) and a relatively narrow posterior stalk (Figs 18, 20). Morphology-based support for a very close relationship is not particularly strong, and it seems probable that there are yet unknown species which are more closely related to these two species than they are to each other.

Zoogeography: The *birmanicus*-group is the northernmost of the species groups in *Liphistius*. Most of its species occur in Myanmar, two in northern Thailand (*L. lahu* and *L. metopiae* sp. nov.) and one in southern China (*L. nabang*). The geographical range of the *birmanicus*-group borders on that of the *bristowei*-group roughly along the frontier between Myanmar and northern Thailand, but no overlap is yet known. *Liphistius lahu* and *L. lannaianus* Schwendinger, 1990 were found only about two kilometres away from each other, on either side of a mountain ridge at Doi Angkhang, on the Thai side of the border. We know of at least two true syntopic occurrences of *Liphistius* species in Myanmar: near Taungoo (= Toungoo) burrows of *L. ferox* sp. nov. were found together with those of an undescribed species in the *bristowei*-group. Based on molecular data, Ono & Aung (2020: 90, 94) reported the existence of two congeneric species (*L. tanakai* in the *trang*-group plus an undescribed species represented only by juveniles)

on Lampi Island in southern Myanmar. All known *birmanicus*-group species are allotopic, which is also the case for the *bristowei*-group and for the species groups in Peninsular Malaysia, but not for the species-rich, widely distributed and ecologically very successful *trang*-group.

ACKNOWLEDGEMENTS

This study was partly carried out in association with the integrated research project "Biological Inventory with special attention to Myanmar" initiated by the National Museum of Nature and Science, Japan, based on a memorandum of understanding between the latter and the Forest Department, Ministry of Natural Resources and Environmental Conservation, Myanmar. We thank the director of the Forest Research Institute, Forest Department, Myanmar and Dr Nobuyuki Tanaka (project leader; National Museum of Nature and Science, Japan) for their support and for arranging permits. The National Research Council of Thailand gave permission to carry out field studies in the kingdom. We are particularly grateful to Dr Dmitri Logunov (Manchester Museum, UK) for reviewing and improving the manuscript, to John Hollier (MHNG) for checking the English text and to Emmanuelle Werlen (MHNG) for entering type specimens into the MHNG database.

REFERENCES

Abraham H.C. 1923. A new spider of the genus *Liphistius* from the Malay Peninsula, and some observations on its habits. *Proceedings of the Zoological Society of London* 1923: 769-774, pl. 1.

Aung K.P.P., Xu X., Lwin W.W., Sang M.Z., Yu L., Liu H., Liu F., Li D. 2019. Two new species of the primitively segmented spider genus *Liphistius* Schiödte, 1849 (Mesothelae, Liphistiidae) from Myanmar. *ZooKeys* 882: 29-39.

Bristowe W.S. 1933. The liphistiid spiders. With an appendix on their internal anatomy by J. Millot. *Proceedings of the Zoological Society of London* 1932: 1015-1057.

Bristowe W.S. 1938. A supplementary note on the liphistiid spiders. *Proceedings of the Zoological Society of London* (series B) 108: 661-662.

Bristowe W.S. 1975. An interesting spider found in Thailand. *Natural History Bulletin of the Siam Society* 26: 166-167.

Bristowe W.S. 1976. A contribution to the knowledge of liphistiid spiders. *Journal of Zoology* 178: 1-6.

Fea L. 1896. Quattro anni fra i Birmani e le tribù limitrofe. Viaggio di Leonardo Fea. *U. Hoepli, Milano*, 567 pp.

Fea L. 1897. Viaggio di Leonardo Fea in Birmania e regioni vicine (LXXVI). Riassunto generale dei risultati zoologici. *Annali del Museo Civico di Storia Naturale di Genova* (serie 2) 17: 385-658.

Gravely F.H. 1915. Notes on Indian mygalomorph spiders. *Records of the Indian Museum* 11: 257-287.

Halliday B., Juvara-Bals I. 2016. Systematics and biology of the mite genus *Ljunghia* Oudemans in Southeast Asia (Acari: Laelapidae). *Systematic and Applied Acarology* 21(6): 830-864.

Haupt J. 1983. Vergleichende Morphologie der Genitalorgane und Phylogenie der liphistiomorphen Webspinnen (Araneae: Mesothelae). I. Revision der bisher bekannten Arten. *Zeitschrift für zoologische Systematik und Evolutionsforschung* 21: 275-293.

Klingel H. 1967. Beobachtungen an *Liphistius batuensis* Abr. (Araneae, Mesothelae). *Zoologischer Anzeiger* Supplement 30 (= *Verhandlungen der deutschen zoologischen Gesellschaft* 1966): 246-253.

Ono H., Aung M.M. 2020. A new species of the genus *Liphistius* (Araneae: Mesothelae) from Lampi Island, Tanintharyi Region, southern Myanmar. *Bulletin of the National Museum of Nature and Science* (series A, Zoology) 46(3): 89-95.

Ono H., Aung M.M. 2022. A record of *Utivarachna phyllicola* (Araneae, Trachelidae) from Lampi Island, southern Myanmar. *Bulletin of the National Museum of Nature and Science* (series A, Zoology) 48(2): 29-34.

Ono H., Schwendinger P.J. 1990. Liphistiid spiders (Araneae, Mesothelae) from central and eastern Thailand. *Bulletin of the National Science Museum, Tokyo* (series A, Zoology) 16(4): 165-174.

Oudemans A.C. 1932. Opus 550. *Tijdschrift voor Entomologie* 75(Supplement): 202-210.

Pape T. 1986. A revision of Oriental and Eastern Palaearctic species of *Metopia* Meigen (Diptera: Sarcophagidae). *Stuttgarter Beiträge zur Naturkunde* (Serie A, Biologie) 395: 1-8.

Platnick N.I., Sedgwick W.C. 1984. A revision of the spider genus *Liphistius* (Araneae, Mesothelae). *American Museum Novitates* 2781: 1-31.

Pocock R.I. 1900. The fauna of British India, including Ceylon and Burma. *Taylor & Francis, London,* 279 pp.

Schiödte J.C. 1849. Om en afvigende Slægt af Spindlernes Orden. *Naturhistorisk Tidsskrift* 2: 617-624.

Schwendinger P.J. 1990. On the spider genus *Liphistius* (Araneae: Mesothelae) in Thailand and Burma. *Zoologica Scripta* 19(3): 331-351.

Schwendinger P.J. 1996. New *Liphistius* species (Araneae, Mesothelae) from western and eastern Thailand. *Zoologica Scripta* 25(2): 123-141.

Schwendinger P.J. 1998. Five new *Liphistius* species (Araneae, Mesothelae) from Thailand. *Zoologica Scripta* 27(1): 17-30.

Schwendinger P.J. 1999. Erratum: Five new *Liphistius* species (Araneae, Mesothelae) from Thailand. *Zoologica Scripta* 28(3-4): 371-377.

Schwendinger P.J. 2013. On two *Liphistius* species (Araneae: Liphistiidae) from Laos. *Zootaxa* 3702(1): 51-60.

Schwendinger P.J. 2017. A revision of the trapdoor spider genus *Liphistius* (Mesothelae: Liphistiidae) in peninsular Malaysia; part 1. *Revue suisse de Zoologie* 124(2): 391-445.

Schwendinger P.J., Ono H. 2011. On two *Heptathela* species from southern Vietnam, with a discussion of copulatory organs and systematics of the Liphistiidae (Araneae; Mesothelae). *Revue suisse de Zoologie* 118(4): 599-637.

Schwendinger P. J., Pape T. 2000. Short communication: *Metopia sinensis* (Diptera, Sarcophagidae), an unusual predator of *Liphistius* (Araneae, Mesothelae) in northern Thailand. *Journal of Arachnology* 28: 353-356.

Schwendinger P.J., Syuhadah N., Lehmann-Graber C., Price L., Huber S., Hashim R., Bhassu S., Monod L. 2019. A revision

of the trapdoor spider genus *Liphistius* (Mesothelae: Liphistiidae) in Peninsular Malaysia; part 2. *Revue suisse de Zoologie* 126(2): 321-353.

Thorell T. 1897. Viaggio di Leonardo Fea in Birmania e regioni vicine. LXXIII. Secondo saggio sui Ragni Birmani. I. Parallelodontes - Tubitelariae. *Annali del Museo Civico di Storia Naturale di Genova* (serie 2) 17: 161-267.

World Spider Catalog 2022. Version 23.5. Natural History Museum Bern. Available at http://wsc.nmbe.ch (accessed in July 2022).

Wunderlich J. 2017. New and rare fossil spiders (Araneae) in Mid Cretaceous amber from Myanmar (Burma) including the description of two new extinct families of the suborder Mesothele, and notes on the taxonomy and palaeo-biogeography of this suborder. *Beiträge zur Araneologie* 10: 72-279.

Xu X., Yu L., Aung K.P.P., Yu L., Liu F., Lwin W.W., Sang M.Z., Li D. 2021. A new species of *Liphistius* from Myanmar and description of the actual male of *L. birmanicus* Thorell, 1897 (Araneae, Mesothelae, Liphistiidae). *ZooKeys* 1031: 41-58.

Yu K., Zhang F., Zhang J.-X. 2021. First new species of the genus *Liphistius* Schiödte, 1849 from China (Araneae: Liphistiidae). *Acta Arachnologica Sinica* 30(1): 36-40.

REVUE SUISSE DE ZOOLOGIE
Swiss Journal of Zoology

Instructions to Authors

The *Revue suisse de Zoologie* publishes original research results of zoological systematics and related fields. All manuscripts will be refereed by taxonomic experts.

Submission of a manuscript implies that it has been approved by all authors, that it reports their unpublished work and that it is not being considered for publication elsewhere.

The language must be English, exceptionally and in well-founded cases French, German, or Italian are possible.

There is no maximal length of the articles, but manuscripts longer than 50 pages should be discussed first with the editors.

A financial contribution may be asked from the authors if the number of colour illustrations exceeds a certain number.

Manuscripts must be submitted via email (rsz.mhn@ville-ge.ch) as an attached Microsoft Word (.doc or .docx) or Rich Text file (.rtf).

For more details on how to prepare your manuscript, please consult the PDF document "RSZ Instructions to Authors" available on our web page or contact us per email.

Revue suisse de Zoologie
Muséum d'histoire naturelle
CP 6434
CH-1211 Genève 6
Switzerland.

E-mail: rsz.mhn@ville-ge.ch

SMITHSONIAN LIBRARIES
3 9088 02040 2244

REVUE SUISSE DE ZOOLOGIE
Swiss Journal of Zoology

VOLUME
129 (2) – 2022

Zamani A. & Marusik Y.M. - A new species of *Plator* Simon, 1880 from Pakistan, with a supplementary description of *P. pandeae* Tikader, 1969 (Araneae: Trochanteriidae) 297-301

Hollier J., Marschall J. & Legendre F. - An annotated list of the Blattodea (Insecta) described by Henri de Saussure. Part 2: the Anaplectidae 303-308

Baldizzone G., Takács A., Szabóky S. & Bozsó M. - *Coleophora santonici* Baldizzone & Takács (Lepidoptera, Coleophoridae), new species from Hungary bred from *Artemisia santonicum* 309-322

Yin Z.W. - *Micropeplus shergyla* sp. nov., the first species of Micropeplinae from Tibet (Coleoptera: Staphylinidae) 323-327

Ronkay G., Ronkay L., Landry B. & Zilli A. - A revision of the *Apamea fasciata* (Leech, 1900) species complex (Noctuidae, Xyleninae, Apameini) 329-341

Cifuentes J., Gilgado J. D. & Bobbitt I. - The woodlice of Switzerland (Crustacea, Isopoda, Oniscidea), with 6 new records from heated greenhouses..... 343-367

Prajapati D. A. & Dudhatra A. V. - First record of the spider genus *Tanzania* Koçak & Kemal, 2008 from Asia, with the description of a new species (Arneae: Salticidae) 369-374

Schwendinger P. J., Huber S., Lehmann-Graber C., Ono H., Aung M. M. & Hongpadharakiree K. - A taxonomic revision of the *Liphistius birmanicus*-group (Araneae: Liphistiidae) with the description of five new species 375-424

Indexed in: Current Contents, Science Citation Index.

muséum genève

Swiss Zoological Society

VILLE DE GENÈVE